vocational and technical education

by hugh warren

on education

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VOCATIONAL AND TECHNICAL EDUCATION

A comparative study of present practice
and future trends in ten countries

by

HUGH WARREN

UNESCO

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PREFACE

In its continuing programme for the exchange of educational information, Unesco undertakes comparative studies which are issued in the series Monographs on Education. *The present volume reflects the increasing importance attached to vocational and technical education in the Member States and the corresponding demands on the Unesco Secretariat for information about this field. The study deals with the provision for and the practice of technical education in 10 countries which have extensive relevant experience. The purpose of the study is both to expose the systems prevailing in these countries and to facilitate a general analysis of the subject by providing a means for cross-reference of the various systems at different stages of the technological student's advancement.*

To carry out this study, the Director-General obtained the services of Mr. Hugh Warren, M.Sc. (Eng.), M.I.C.E., M.I.Struct.E., Principal of the South East London Technical College. The author has wide experience in technical education and direct knowledge of the conditions in most of the countries described. He remained entirely free to organize material and to draw the conclusions he felt were justified. As is customary, the Unesco Secretariat defined the task to be undertaken, assisted the author by making available to him as much information as possible, edited the manuscript, and saw the final work through the press.

The author feels that it is too optimistic to hope that no omissions, mistakes, or misunderstandings have occurred, in view of the nine languages and thousands of technical terms which made up the material for the study. He would therefore appreciate being notified of any mistakes that might have occurred so that they may be rectified in future publications of this type.

The comparative method employed does not imply comparison of the better-worse variety, but only an appreciation of individual national contributions to solving a general problem. Moreover, such a basis of comparison is appropriate to the subject, for no country has all the best methods; each has something to learn and much to teach. The author hopes therefore that the comparisons made in Chapters IV, V and VI will be accepted in that spirit, rather than as criticism in any sense.

The opinions expressed in this book are those of the author and do not necessarily reflect the views of either the Inner London Education Authority or Unesco.

ACKNOWLEDGEMENTS

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CONTENTS

INTRODUCTION

The material environment we now live in, the instruments of our daily work, the processed foods we eat, sometimes the very air we breathe, have come about as the result of technical development. Likewise a nation's economic well-being, its standard of living, its potential growth and security, all depend very greatly on the efficiency of its system of technical education and training and on the amount of effort and finance the nation is willing to devote to it. Technical education is far from being the only factor in a nation's economic growth, but it is certainly an essential component.

Yet this very system—its structure, methods and techniques—has risen above the subconscious level of thought and planning only in recent years. Even now, for many administrators and even educators, vocational and technical training is an unknown territory. Moreover, the expert in the subject, though he may be thoroughly familiar with the complexities of his own country's system of training, often has little idea of what goes on across the neighbouring frontier. This is understandable enough. The intricate methods of advancement, the several hundred different programmes pertaining each to separate occupations, the various levels of training, all bearing the stamp of history, tradition, and social sanction—these things provide at first sight an incoherent pattern.

Yet in recent years, a comparative study to improve co-operation in this field of activity across international boundaries has become a functional necessity. First, the migration of skilled workers within regional areas such as the European Economic Community, the Scandinavian countries, Eastern Europe or the North American continent has made some equivalence of diplomas necessary, and has brought about some interesting co-operation in this respect, e.g., the joint United States/Canada accreditation schemes for engineering colleges by the Engineers

Council for Professional Development. The proposed harmonization of skilled worker qualifications through the European Community is another example.

Second, those who are or will be advising the many developing countries on technical education are in a better position to do so if they are able to draw on experience or knowledge of several varied schemes in many countries, especially if the national pattern in their own country is unsuitable for direct transplantation.

The substance of this study has therefore been arranged not to give detailed technical information on any one training programme—to cover 600 trades in 10 countries would be an encyclopaedic task—but to provide a synoptic review and broad comparison of the systems of the 10 countries chosen. In Chapters I, II and III, the countries are considered individually. Chapters IV, V and VI are devoted to national comparisons and to a discussion of future trends.

Even such a limited objective has no clearly marked boundaries. There are common frontiers with industrial training, university studies, adult education, general secondary education, and teacher training which no 'boundary commissions' have ever mapped in detail. Teacher training would be an extensive comparative study in its own right and has here been touched on only superficially.

Finally, the problem which transcends all others—the relation of technics to humanity—would, despite its educational value in promoting attempts to 'liberalize' technical education, raise too many philosophical issues to be tractable within the compass of this study.

The status and purpose of technical and vocational education could not be better expressed for international purposes than has been done in paragraph 7 of the recommendation adopted by the General Conference of Unesco in 1962: 'Technical and vocational education should be an integral part of an over-all system of education and, as such, due consideration should be given to its cultural content. It should do more than train an individual for a given occupation by providing the persons concerned with the necessary skills and theoretical knowledge; it should also, in conjunction with general education, provide for the development of personality and character and foster the capacity for understanding, judgement, self-expression and adaptation to varying environments. To this end, the cultural content of technical and vocational education should be set at such a level that the inevitable specialization in technical

and vocational education does not stifle broader interests.[1]

Technology itself is a means, not an end. Hence a true education, in whatever field of activity, must say as much about the end as it says about the means of achieving it. For only so can man reach fulfilment.

1. Unesco, *Technical and Vocational Education. Recommendations by Unesco and the International Labour Organisation.* Paris Unesco and Geneva, International Labour Organisation, 1964, 36 pp. Also published in French, Russian and Spanish.

CHAPTER I

SYSTEMS OF GENERAL EDUCATION

It is not the purpose of this study to evaluate the systems of general education prevalent in the various countries under consideration; yet, a basic knowledge of them is essential if the structure of technical education is to be appreciated in perspective. Moreover, changes in the school systems of some of the countries have profoundly modified the entry conditions for the beginning years of technical education.

An up-to-date knowledge of current educational practice and philosophy in each country is therefore a necessity if the technical educator is to see the whole picture. The converse is equally true: those whose working lives are spent in the field of general education should have some appreciation not merely of university opportunities but of the more numerous post-school opportunities now available in vocational and technical education.

There is, of course, no clear boundary between general and technical education, nor should there be. The former aims at cultivating the mind to harmonize it with the world; the latter aims at changing the material world to suit the aspirations of the mind. This is not to postulate a sharp antithesis between the two, but rather to show the need for both these components to be regarded as complementary.

Further details on the structure of administration in each country, its basic statistics and its educational services may be found in many standard national studies, and some regional or international publications, the most comprehensive of which is *World Survey of Education* (Vols. I, II, III and IV) published by Unesco.

Appendix I reproduces the sample schemes annexed to the Unesco recommendation concerning technical and vocational education; these programmes are related to years of previous general education in school.

CZECHOSLOVAKIA

ADMINISTRATION

In Czechoslovakia education is the responsibility of the State. The Ministry of Education and Culture delegates much of its authority to national committees, each of which is responsible for a local district. 'They shall ensure the steady development of education on the basis of the State plan for the development of the national economy and culture and the State budget.'[1] Schools, pre-primary school and out-of-school facilities shall be established by the National Committees.'[2] 'With consent, other socialist organizations including factories and co-operatives may co-operate out of their own resources.'[3]

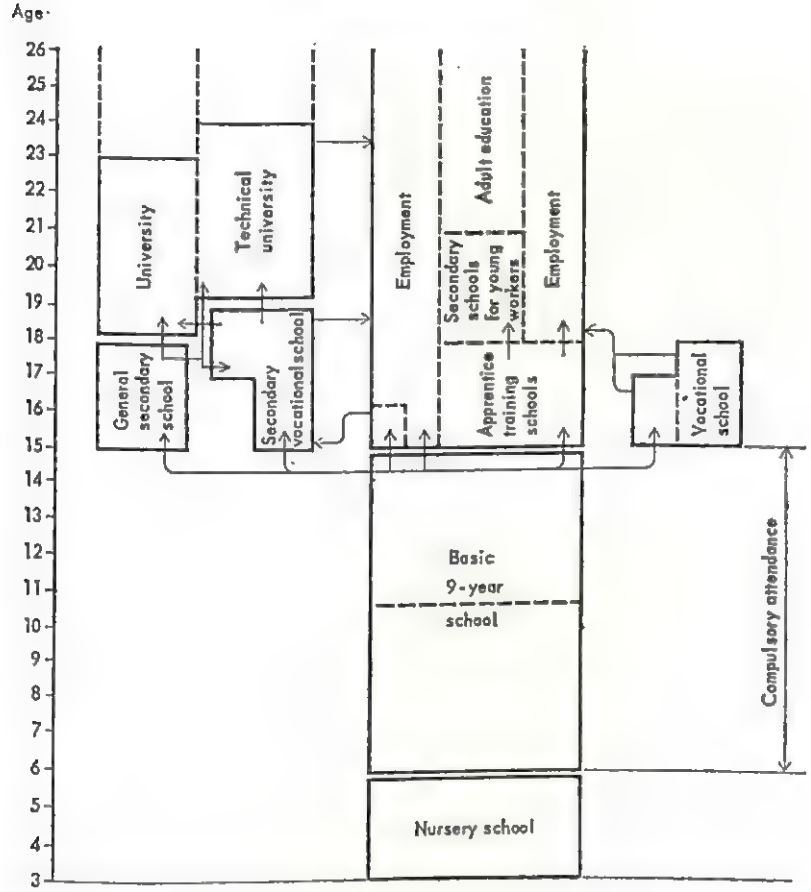
Whilst some of the main lines of present-day education were laid down in the Act of 1953 which reaffirmed 8-year education for everyone up to 14 years, the present position is based on the sweeping provisions of the Education Reform Act of 15 December 1960.

Since the 1953 Act there have been almost yearly change and developments in the national structure of education. From 1957 the Ministry of Education took complete charge of apprentice training. From 1959 to 1962 the leaving age was progressively raised, region by region, from 14 to 15, thus demanding a 9-year compulsory attendance. From 1960/61 all textbooks were supplied free of charge. From 1962 the curriculum for apprentice training included a minimum of two days per week instead of one for general and technical theoretical subjects. In 1959/60 the 'secondary schools for workers' were developed by which part-time classes prepare young workers for university entrance or other higher studies.

Finally, the Act of 1960 speaks of education as a preparation for life in a modern socialist society, involving the concepts of 'polytechnical education' even in academic schools, and extending the provisions for part-time education of the workers to the highest levels. It is 'a means for the abolition of one-sided intellectualism in education (and of) bridging the gap between manual labour and brainwork.'[4] In addition, education is free of charge

1. Law concerning the system of education—school law—approved by the National Assembly on 15 December 1960, Section 31. *Věstnik Ministerstva školstvi a kultury*, vol. 17 31 January 1961, I-II, p. 1-7.
2. ibid, Section 30.
3. ibid, Section 30.3.
4. op. cit., 'Preface' (cf. p. 2).

Czechoslovakia



in basic, secondary and higher education. Charges may be made in schools of art, schools of language and for certain other educational facilities.

PRIMARY EDUCATION

Primary education does not exist as such in Czechoslovakia. Instead, all children receive a basic schooling of 9 years, regardless of what they may choose to specialize in later. This basic education is divided into two stages. In the first stage for students from 6 to 11 years, a single teacher teaches all except specialized subjects. In the second stage for students from 11 to 15 years, teachers tend to specialize in one or two subjects. At the completion of the second stage, the student may apply for admission to one of several different kinds of more specialized schools to finish his secondary education.

SECONDARY EDUCATION

The general secondary school (střední všeobecně vzdělávací škola)

The general secondary school is a 3-year course which was formerly severely academic and concentrated exclusively on university entrance. It now incorporates the concept of polytechnical education for a minimum of 8 hours per week, 2 of which are spent in theoretical studies and 6 in practical studies. The course terminates at the age of 18 with the 'maturity' examination and provides access to higher education in a university or elsewhere. From 1956/57 this latter possibility was facilitated by special 2-year vocational school courses for those leaving the 3-year secondary course. About 20 per cent of the national age group enters these vocational schools.

In 1956/57 the option of three curricula was established and this was amended and confirmed in 1960 to be: (a) general education (Latin is non-compulsory); (b) mathematics/physics; (c) chemistry/biology.

These specializations are in addition to a common schedule of 14, 12 and 11 hours of general education in the three years respectively. Latin, art, technical drawing, laboratory work and sports are non-compulsory subjects. Only one can be chosen for 2 hours per week.

The basic technical component in the syllabus, which includes one day per week on productive work, provides a basis for a shortened training as a skilled worker or as a technician after leaving. Graduates from the general secondary school who desire to enrol in the secondary vocational school are eligible for a special 2-year programme (see below).

The secondary vocational school (střední odborná škola)

The secondary vocational school accepts leavers from the second stage, but there is an increasing tendency to require 1 year of prior practical experience, preferably in apprenticeship training. The course is of 3 or 4 years and provides both the general maturity certificate and technical competency. Graduates of these schools may either proceed to a university or take up employment in industry.

The course is shortened to 2 years for entrants coming from the general secondary school described above. About 20 per cent of the children in the relevant age group are admitted to these schools.

The 2-year vocational school (odborná škola)

The 2-year vocational school gives continued general and technical education following the 9-year school but does not provide full secondary 'maturity'. The leavers take up employment and may continue their education part-time in the secondary schools for young workers.

The apprentice training centres and apprentice schools

Apprentice schools provide a combination of skilled worker training and continued general education mainly upon industrial premises. After qualification, further education may be acquired as described under the next heading. Nearly 60 per cent of the young workers in the relevant age group are engaged in organized training programmes of this nature. The secondary schools for young workers were established in 1959. Their object is to provide the full complement of secondary education which the young worker temporarily deferred upon leaving school at the age of 15 years. He spends eight hours per week on studies, and eight at work. Following a 3-year apprenticeship and qualification, the course lasts either 2 or 3 years. Those having had a partial secondary education already may, after an examination,

be admitted directly to the third or final year. Special concessions in regard to working hours encourage both young people and adults to participate. More than 100,000 employed persons gain diplomas for the successful completion of secondary studies through 'non-residential' courses each year.

HIGHER EDUCATION

There are four types of institutions for higher education: technical universities and institutes, traditional universities, art academies, teacher-training institutes. University tuition is paid by the State, and a system of scholarships up to 1,200 crowns a month helps married students to maintain their families. An additional 100 crowns per month for scholastic successes may be granted. Admissions are according to a quota system which is fixed in accordance with the national economic plan. Employment is thus assured for the graduates.

There are 14 technical institutions of university status headed by the Technical University of Prague (founded in 1707). In these institutions, the courses last 5 to 6 years, and combine both theoretical study with industrial experience. There are seven universities of the general type, including Charles University, Prague (founded in 1348) and these are also closely allied to the productive life of the country. Surveys show that some 50 per cent of students come from working-class homes.

ADULT EDUCATION

An extensive system of general and technical education has been established in recent years, and is growing rapidly. Evening classes and correspondence courses duplicate almost every aspect of the full-time education system, including university level. Evening classes meet for 14 hours per week (usually a 3-year course). In correspondence (non-residential) courses, meetings are arranged with the tutor once per week for six hours and other extramural studies provide for those who cannot attend weekly.

FRANCE

ADMINISTRATION

Responsibility for public education in France is centralized, and lies with the Ministry of National Education, although a number of other ministries also exercise educational powers and functions, e.g., agriculture, defence, justice, etc.

The administrative structure of the ministry comprises two main academic divisions: the Department of Scholastic Programmes and the Department of Higher Education and Research. In addition there are executive divisions for general services and administration; school equipment, health, libraries and external relations.

The ministry is assisted, and represented, by a national body of inspectors *(inspecteurs généraux)* each specializing in a different field.

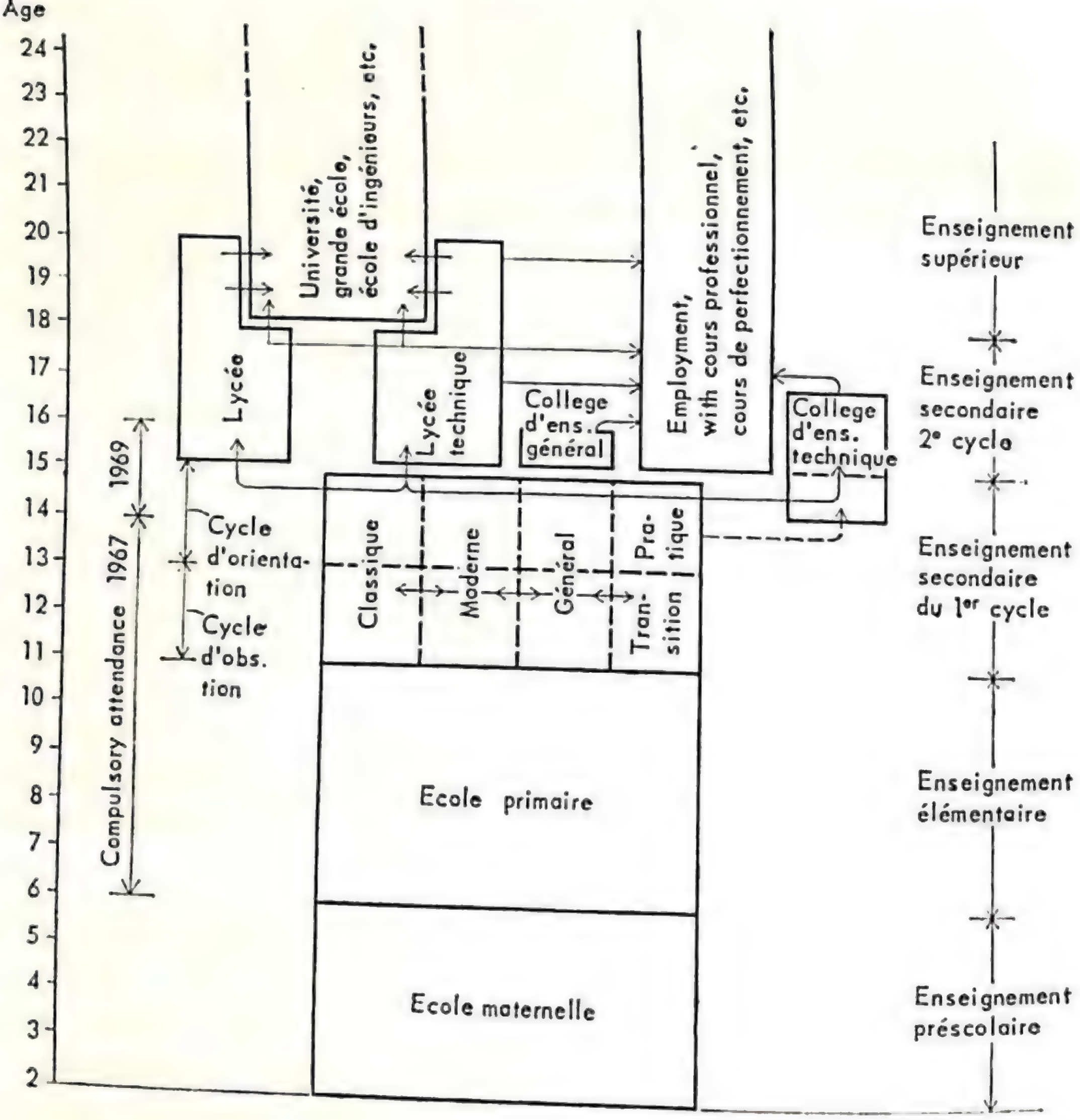
Educational administration in France is divided into 19 regions *(académies)*, each of which is administered by a rector who is responsible to the minister. An *inspecteur d'académie*, assisted by specialized inspectors for specific subjects, is delegated to supervise each county *(département)*.

All teaching personnel in public education are paid by the State although the provision and maintenance of school buildings is often the administrative and financial responsibility of the municipal authorities.

School attendance is compulsory between the ages of 6 and 14 and is being extended to 16 in the years 1967-69. Tuition is free, except for certain university registration fees and, of course, those of private schools. Scholarships are available from age 11 upwards. Public education is entirely secular, and free from religious and political orientation. Standards of instruction, examinations, qualifications of staff and the general educational structure are uniformly maintained throughout the country, although they may be adjusted to suit local conditions.

The Reform of Education Act 1959 radically changed the older structure, in which the first three of the four 'orders' of education—primary, secondary, technical and university—had become almost autonomous bodies with vertical separation by quality, rather than horizontal division by age of pupil. The Act of 1959 and subsequent decrees provide for pre-primary school education, non-compulsory from 2 to 6 years; elementary education, from 6 to 11 years; secondary education, from 11 to 15, first

France


Age
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4
3
2
1969
Compulsory attendance 1967
Cycle d'orientation
Cycle d'obs. tion
Université, grande école, école d'ingénieurs, etc.
Lycée
Lycée technique
College d'ens. général
Employment, with cours professionnel, cours de perfectionnement, etc.
College d'ens. technique
Classique
Moderne
Général
Pra- tique
Tran- sition
Ecole primaire
Ecole maternelle
Enseignement supérieur
Enseignement secondaire 2e cycle
Enseignement secondaire du 1er cycle
Enseignement élémentaire
Enseignement préscolaire

cycle and from 15 upwards, in 5 main streams; higher education, from 18 upwards, in several forms.

PRIMARY EDUCATION

Elementary education is provided in primary schools *(écoles élémentaires)* in three phases *(cours): préparatoires* (6-7), *élémentaires* (7-9) and *moyens* (9-11), and gives the basic knowledge to pursue one of the options which follow. The programme of elementary education is the same for all pupils regardless of what they may specialize in later.

SECONDARY EDUCATION

The first cycle

The first phase of secondary education, 11-15 *(enseignement secondaire du premier cycle)* is now intended to be as general as possible, postponing any final choice of career until after 15 years of age. The first two years, 11-13, are a diagnostic period *(cycle d'observation)* in which ability and aptitude are assessed, and during which transfer and re-transfer from course to course is facilitated.

At the end of the 2-year *cycle d'observation*, a second 2-year period, known as the *cycle d'orientation* begins. The pupil, based upon his aptitude and work done during the *cycle d'observation* chooses one of four courses *(sections)* of study made available to him: classical, which includes Latin and/or Greek, and one or two modern languages; modern, two programmes, either 'Modern I' including French and two modern languages, or 'Modern II', with only one modern language (courses in technology are sometimes included in the 'modern' programmes; and practical, specializing in non-specialized, pre-professional courses.

Where formerly the different programmes undertaken during the *premier cycle* were taught in separate schools specializing in a given course, the practice now following a recent reform (1962) is to group them all in schools called *collèges d'enseignement secondaire*.

Transition from the previous system has not, however, been completed. Three types of schools continue to provide programmes for the first cycle: *lycées* (classical and modern); *collèges d'enseignement général* (modern II) and *collèges d'enseignement secondaire* (grouping all programmes and facilitating transfers).

Second cycle

The pupil, having completed his general education at age 15, chooses a programme more oriented toward the profession he will ultimately practice. According to his wishes and those of the school, he will choose a technical or general programme. Then, according to whether he wishes to take his *baccalauréat* examination and continue into higher education or not, he will choose whether he wishes to take the long or short course. These four main programmes—that is, *enseignement général long* or *court* (short) and *enseignement technique long* or *court* were established in principle in the 1959 reform. There is one additional programme, *enseignement terminal*, which is explained below.

1. *Enseignement général long* is a 3-year programme given in the *lycées classiques* or *modernes*, designed to prepare the student to pass the *baccalauréat* in his option and to continue on to higher education.
2. *Enseignement général court* is a 2-year programme given in the *collèges de second cycle* (formerly *collèges d'enseignement technique*) and in the *collèges d'enseignement général*. It includes some professional training and prepares the student to pass the required examination necessary to practise the middle-level profession. The diploma received is called the *brevet d'enseignement général* and bears the name of the speciality chosen by the student.
3. *Enseignement professionnel long* is a 2- to 5-year programme, depending upon the course, given in *lycées techniques* (formerly *écoles nationales professionnelles*) and is designed primarily to train technicians. The 3-year course has an option for preparing the *baccalauréat de mathématiques*.
4. *Enseignement technique court* is a 2-year course which trains people as *agents techniques*, being the technically trained manpower for industry and commerce. It takes students from the first cycle regardless of their previous type of programme and gives them a theoretical and practical background. These courses are given in *collèges d'enseignement technique* (formerly *centres d'apprentissage*). The training prepares the studies for the diploma known as the CAP *(certificat d'aptitude professionnelle)*.
5. *Enseignement terminal* is a programme, devised in 1959, which gives courses in general studies alternated with shifts of practical training in an industry. It is intended for students who have been found to be not sufficiently intelligent to follow one of the programmes outlined above. It may be that with

further experience in the working of the reform, these lower-than-average pupils may be fully and suitably accommodated in the practical options of the first cycle, 11-15, even when the obligatory age is raised in 1968 to 16, since their actual age will usually be above normal.

HIGHER EDUCATION

A reform of higher education is under study at the present time following several modifications in the *baccalauréat*. It is expected that in 1966 the new *baccalauréat* will not necessarily give access to a university but will allow the student to enter higher education itself, a preparatory class for the *grandes écoles*, or in special institutes designed to train the *cadres moyens*. Access to a university will be reserved to students who received a sufficiently high pass on their *baccalauréat* examination.

At present, higher education is constituted by two main groups of institutions (including public and private): *universités* and *grandes écoles*.

The universities, of which there are now 20, with two more planned at Limoges and Nice, traditionally include only five faculties: science, letters, law, medicine, pharmacy. Technology is, therefore, as in many other countries, not provided for within the university proper, although this distinction is growing less rigid. Attached to the universities are institutes, providing for specialized studies and high-level technological research. The *baccalauréat*, or its equivalent, is required for entry to such universities and institutes. The State-awarded qualification gained after such studies is the *licence*, and with further studies, the *diplôme d'études supérieures*, *agrégation*, and/or *doctorat*.

The *grandes écoles*, both private and public, are in many instances wholly devoted to higher technological studies. The École Centrale des Arts et Manufactures, the École Nationale Supérieure des Arts et Métiers, and the École Nationale Supérieure de l'Aéronautique are three examples out of many. Preparation for entry, normally after a *baccalauréat (mathématiques)* is provided by special courses of 2 to 3 years' duration in a number of *lycées*. The course at the *grandes écoles* extends over 4 years and awards the legally protected title of *diplôme d'ingénieur*.

A recent development is the provision of five (to be increased to seven) new *écoles d'ingénieurs de fabrication*. These institutes provide a 4-year course, entry being given through a competitive examination, following completion of the course for *techniciens*

in the *lycées*, previously mentioned. The *baccalauréat* is not essential. This type of training replaces that given in the former *écoles nationales d'ingénieurs, arts et métiers*, which have now been upgraded.

ADULT EDUCATION

During the last 10 years there has been a marked development of adult education of a vocational type *(cours de promotion du travail)*. Organized by the Ministry of Education under the general aegis of the Délégation Générale à la Promotion Sociale, the object of the movement is to provide educational opportunities—correspondence courses, part-time classes, television courses, etc.—by means of which adults who have not completed their education may gain a qualification and thus increase their employment possibilities as well as the nation's productivity.

Such work has long been carried on in Paris by the Conservatoire National des Arts et Métiers, founded in 1794, and recently extended into 20 provincial towns comprising 40 separate educational centres. It is possible although exceptionally arduous to reach the qualification *diplôme d'ingénieur* by this route.

Some universities, notably Grenoble, Lille, and the Institut National des Sciences Appliquées in Paris, have successfully experimented with admissions drawn from the large numbers attending these part-time courses, irrespective of traditional qualifications such as the *baccalauréat*.

FEDERAL REPUBLIC OF GERMANY

ADMINISTRATION

Education in Germany is the responsibility of the provinces *(Länder)* of which there are 11 (including the city-states of Berlin, Bremen and Hamburg). There is no federal Ministry of Education, although there are various joint arrangements between the *Länder* for consultation, documentation and statistics.

Various local authorities—the *Kreis* (community) and the *Gemeinde* (district)—or private bodies, may provide the school plant, but the teaching staff, the curriculum and the methods of

instruction are the responsibility of the province acting through local or regional offices.

In accordance with the law of 6 July 1938, full-time attendance is compulsory between the ages of 6 and 14. In Bremen, Hamburg, Schleswig-Holstein, West Berlin and Lower Saxony, the upper age is now 15. Part-time day attendance is compulsory up to 18, unless replaced by equivalent full-time studies.

There are no fees for instruction in primary education or in the compulsory part-time day courses. In secondary and technical education, fees are disappearing and have already been abolished in some *Länder*.

PRIMARY EDUCATION

Primary education is given in the *Volksschule* to children between the ages of 6 and 14. The first four years are known as the *Grundschule* and the remaining four (or five) as the *Oberstufe*. At the age of 10, that is, at the end of the *Grundschule*, a child may go on to one of the forms of secondary education described below. Some later transfers also take place at the age of 12 to the 4-year *Mittelschule*, etc. (cf. 'Secondary education' below). Failing such transfer the pupil continues in the *Volksschule* until 14 or 15 years of age.

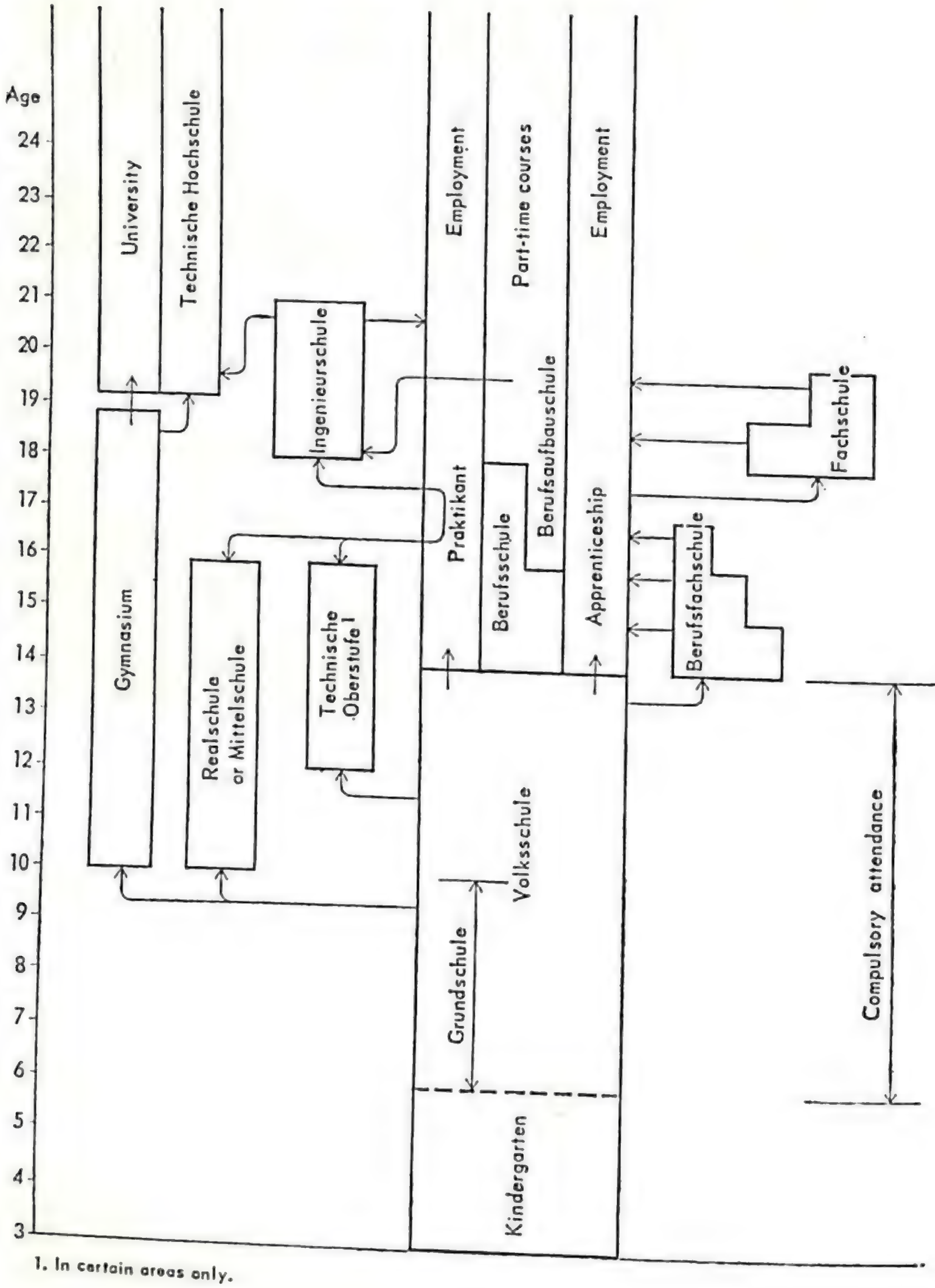
SECONDARY EDUCATION

'The time at which pupils change over to secondary education varies according to their aptitudes and particular gifts; it may be at the end of the fourth, sixth or seventh year in the case of a general secondary school *(Gymnasium* or *Mittelschule)*, or at the end of the eighth or ninth year in that of vocational secondary school (part-time *Berufsschule* or full-time *Berufsfachschule)*.'[1] Vocational guidance orients the student to the appropriate programme.

The *Gymnasium* is the most complete form of secondary education. The course extends for nine years up to the *Abitur*, the qualification needed for entry to a university or *Technische Hochschule*. In the *Gymnasium*, the student may choose one of three main options: *Altsprachliches* (classical languages), *Neusprachliches* (modern languages) and *Mathematisch-naturwissenschaftliches* (scientific studies).

1. *World Survey of Education*. Vol. III: *Secondary Education*. Paris, Unesco, 1961, p. 572.

Federal Republic of Germany



1. In certain areas only.

The *Mittelschule* or *Realschule* is for less-qualified students and gives a 6-year course up to the age of 16, which prepares students for a degree called the *Mittlere Reife*. Although it teaches one or more foreign languages, the course has a more practical basis than that offered in the *Gymnasium*. The graduate is trained for immediate employment even though he may return to full-time education in a *Fachschule* (advanced full-time vocational training schools). After leaving a *Mittelschule* at 16, the student may become employed as a trainee *(Praktikant)*. After two years, the student may enter an *Ingenieurschule* through a special entrance examination if he does not already hold the *Mittlere Reife*.

The *Berufsschule* is a part-time vocational school where students not enrolled in some other programme are required to attend, usually until the age of 18. The student continues his vocational and general education one day a week, or for approximately 9 hours. An ambitious student may also attend evening classes three or four evenings a week at a *Berufsaufbauschule* to supplement his studies at the *Berufsschule*. If he fulfils all the requirements, he will obtain a *Fachschulereife*, the certificate necessary for entrance to a *Höhere Fachschule* (or *Ingenieurschule*, or *Technikum*). Here, he may pursue his studies full-time.

The *Berufsfachschulen* are full-time vocational schools of 1 to 3 years' duration whose aim is to train people for a practical profession. Often attendance at one of these schools together with two years' practical experience will qualify pupils for admission to a *Fachschule*.

There is another possible choice in some *Länder*. After acquisition of the *Fachschulereife* by either of the two means described, the student may apply for admission to a special institute where he may gain, along with students still in their teens or with adults, the *Hochschulereife (Abitur)*, i.e., the qualification necessary to enter a university of *Technische Hochschule*. This type of establishment, offering a 2-year full-time course, is known as an *Institut zur Erlangung der Hochschulreife*. There are also evening courses fulfilling a similar purpose in the *Abendgymnasium*.

These various options enable a graduate of the *Volksschule*, by successive steps of part- or full-time study, to gain entry to a university or *Technische Hochschule*, or to an *Ingenieurschule*. They are all part of a post-war development known as *Der Zweite Bildungsweg* —the second educational route. This system has developed the most in the industrial areas of the Ruhr, and specifically in the province Nordrhein-Westfalen.

Proposed reform of secondary education

Under the proposed reform, not yet fully elaborated or implemented, secondary education would be divided into two stages: (a) the *Hauptschule*, or *Realschule*, which is the shorter programme; (b) the *Gymnasium*, or *Studienschule*, which is the longer programme. Six years would be spent in the *Volksschule*, the last two years of which would be diagnostic *(Förderstufe)*. The pupil would then be selected, at first by examination and later by records and observation, for either the *Hauptschule*, giving a 3-year course and later a 4-year course of a terminal nature; the *Realschule*, giving a 5-year course leading to the *Mittlere Reife* and possible transfer for the gifted to the *Gymnasium;* or the *Gymnasium*, giving a 7-year course leading to *Abitur* and possible entry to a university. The first two years of the present *Gymnasium*, from age 10 to 12, would be absorbed by primary education. The *Studienschule*, the classical variant of the *Gymnasium*, would still recruit at 10 years of age from the primary school, taking only pupils showing an exceptional inclination towards studies of philological/historical subjects. Latin would be compulsory from the outset of the 9-year course, with either Greek or French in addition. The course would lead to *Abitur* and then potentially to a university.

HIGHER EDUCATION

Higher education is provided in universities or *Technische Hochschulen* and special institutions. German universities comprise the usual faculties of philosophy, theology, law, medicine, and sciences. Special faculties for social sciences are being increasingly introduced. At some universities there are more specialized faculties such as a faculty of pedagogy in the *Land Hessen*. New universities are being established, some of which will offer variations of the traditional concept of university education.

Technological studies leading to professional status are provided in the eight *Technische Hochschulen* and in the *Technische Universität* in Berlin. The first degree is the *Diplom Ingenieur* and facilities exist at all these institutions for post-graduate and research work. *Technische Hochschulen*, like universities, are composed of several faculties.

Higher education below university level is provided by the *Ingenieur-Schulen* preparing for the degree *Ingenieur*. *Ingenieurs* occupy the highest positions in the middle cadre of industry;

the most successful students leaving the *Ingenieurschulen* have the option of continuing their studies at a *Technische Hochschule* after having obtained the *Facultätsreife*. In order to give proper recognition to *Ingenieurschulen*, it is at present under consideration to replace the old term by *Ingenieurakademie*.

Also below university level are other forms of *Fachschulen* or *Höhere Fachschulen* who prepare their students, very often after some time of practical work in industry or other appropriate positions, for employment in middle-level positions (e.g., social workers, librarians, etc.).

Mention must also be made of the *Pädagogische Hochschulen* which accepts students holding the *Abitur* who seek training to become primary-school teachers. The level of these *Hochschulen* is between that of a university and an *Ingenieurschule*, in that they accept in general only students holding the *Abitur* but do not provide for post-graduate studies and do not confer higher degrees.

ADULT EDUCATION

Adult education in Germany is given by various bodies (states, communities, churches, trade unions, professional bodies, etc.) through a variety of programmes. However, three main groups may be distinguished:

1. Adult education courses aiming at higher certificates such as the *Mittlere Reife* for primary-school leavers, or at the *Abitur* for graduates from the Mittelschule; *Institut zur Erlangung der Hochschulreife* (see above) and other forms of the *Zweite Bildungsweg* (see above). As a rule the courses are organized by the school authorities of the states *(Länder)*, but correspondence courses and part-time education in this category are also offered by private organizations.
2. Adult education aiming at immediate employment in the field studied. This heading includes languages courses for commercial professions, book-keeping courses, and courses introducing new techniques to skilled workers or new technological processes and their theory to professional engineers. Most of the training of *Technikern* is done in this group in the form of night classes.
3. Adult education aiming at improving the general culture of the participants, and at the development of a political and civic conscience. The most important form of this group of activities for the education of adults is carried out by the

Volkshochschulen (people's high schools), in the form of night courses in the *Heimvolkshochschulen* which provide board for participants. Fees are low and often only nominal.

ITALY

ADMINISTRATION

Responsibility for the public sector of education rests with the Ministry of Education. Administration is carried out through provincial and local offices and the school buildings are normally provided by the commune. Teachers' salaries are paid by the State. All examinations are State-directed and approved and are administered publicly.

Private schools exist in considerable number and account for some 20 per cent of secondary enrolments. They are closely supervised both at primary and secondary level.

Attendance is compulsory between the ages of 6 and 14. The latter age, introduced in 1923, has recently been re-confirmed with stronger measures to make it more effective. In some of the poorer districts of the south, the full 8-year period had not always been achieved.

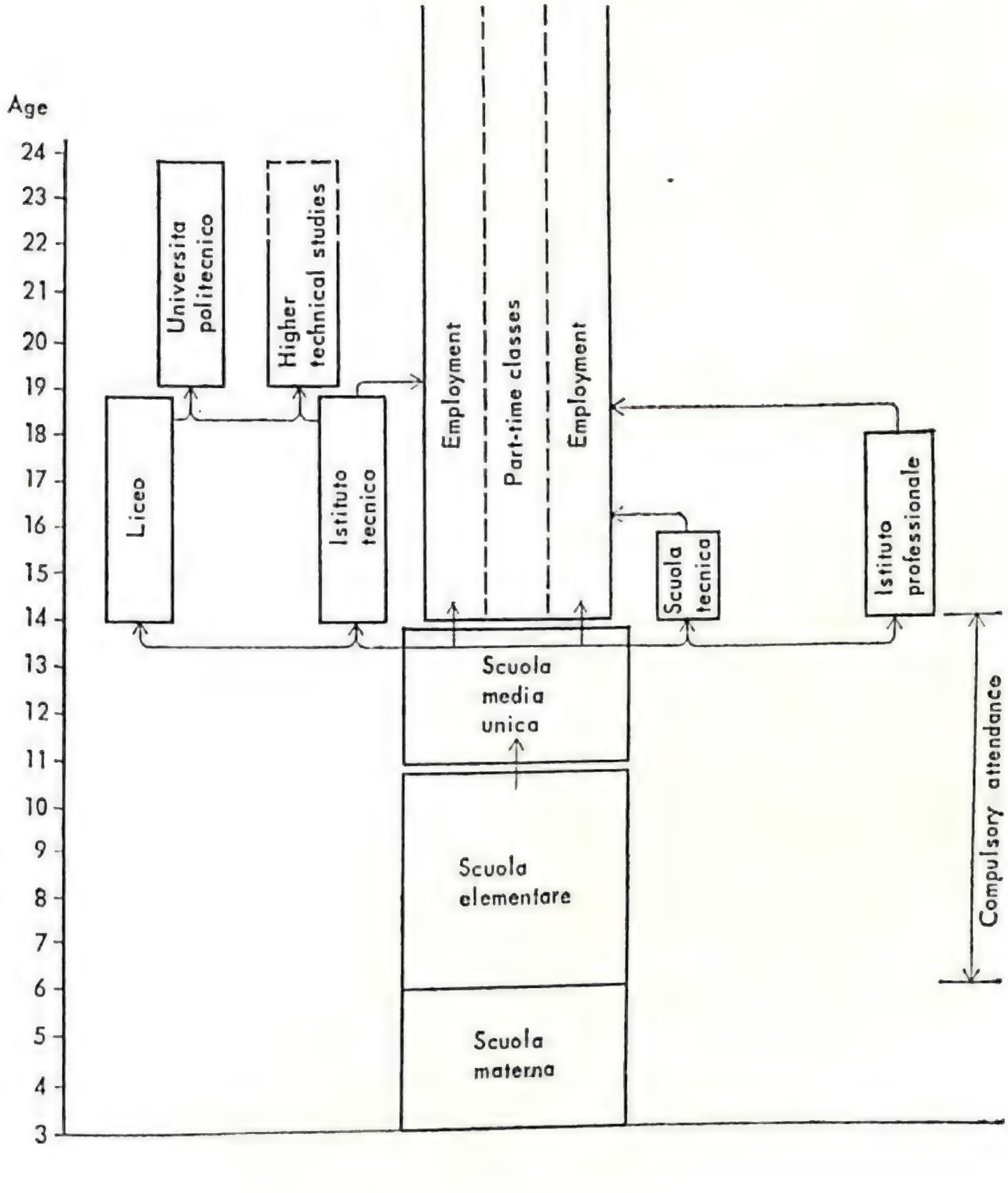
PRIMARY EDUCATION

Primary education commences at 6 years of age, and provides two periods of 2 years and 3 years respectively. Until recently, primary education could be followed, for a small number of pupils, by a third stage of post-elementary education which, since 1955, provided an extension and revision of the first two cycles with some vocational bias. Most students, however, transferred at the age of 11 to one of the forms of lower secondary education described below.

SECONDARY EDUCATION

Secondary education is divided into a lower and upper stage. The lower stage, up to October 1963, had two divisions: (a) *scuola media*, giving the more academic form of education and possible entry to the higher secondary stage; (b) *scuola d'avviamento*

Italy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Università politecnico
Higher technical studies
Liceo
Istituto tecnico
Employment
Part-time classes
Employment
Scuola tecnica
Istituto professionale
Scuola media unica
Scuola elementare
Scuola materna
Compulsory attendance

professionale, giving a more practical and vocational form of education. From October 1963, these two types were combined into one comprehensive school known as *scuola media unica*. This provides a common 3-year course from 11 to 14 years, the only variation being in optional subjects taken as additions to the normal programme during the second and third years. Special attention is to be given to backward pupils so that all may have the same opportunity to earn the diploma *licenza*. Only those who take Latin in that examination may gain entry to a *ginnasio* or *liceo classico*.

The upper level of secondary education has many branches of which the most important numerically are:

1. *Ginnasio* and *liceo classico* providing a full secondary education in classical subjects and after 5 years' study the degree of *maturità*, which permits entrance to a university in any faculty.
2. *Liceo scientifico* giving the modern or scientific form of full secondary education; also awards the qualification *maturità* after a 5-year course of study. Entrance to a university in any faculty is possible, except in the faculty of arts.
3. *Istituto tecnico* (industrial, commercial, agricultural, naval, etc.) is a senior technical school giving a 5-year course in an applied science type of curriculum and with basic technical studies of a more specialized character. For most of the students at the *istituto tecnico*, employment in the middle ranks of industry is intended, after gaining the qualification *abilitazione tecnica*. However, the more promising may enter a university (Law of 1961) in some but not all of the faculties.
4. *Istituto magistrale* also provides a 4-year course and is designed as a form of teacher training for the primary schools.

There are two other forms of upper secondary education of particular interest in technical education. The first is *scuola tecnica*, which gives a 2-year full-time skilled worker training as an alternative to apprenticeship in industry. Here the emphasis is practical rather than academic, often because of inadequate prior education. This type is now rapidly being replaced by the second, *istituto professionale*. This school gives a 3-year course combining practical instruction with basic scientific and technical theory. Extension courses from a 'half- to one-year's duration' are available in some subjects and lead to junior technician levels.

There is provision for the best of the pupils in the two last-named schools to enter an *istituto tecnico* at an appropriate level, and thus continue their studies.

HIGHER EDUCATION

Higher education in Italy is provided in various types of institutions. Of these, the degree-granting universities and higher institutes are the only schools which provide advanced professional and technical training recognized by the State. The main distinction between these two types is that the former has several faculties and the latter only one.

Admission to all university courses other than educational ones is available to holders of the *diploma di maturità classica*. A similar degree for science opens the door to all university courses other than those in the faculty of letters and philosophy.

Courses for training engineers *(ingegnere)* are available at 12 centres, 10 of these being faculties of universities (Genoa, Padua, Trieste, Bologna, Pisa, Rome, Naples, Bari, Palermo, Cagliari), and the other two being polytechnic institutes (Milan and Turin). Similar faculties and institutes exist for architecture, naval construction and other applied sciences.

The receipt of the *laurea* marks the successful completion of a course usually taking at least 4 years. The holder of the *laurea* has the title of *dottore* which is a purely academic title. Should he wish to practise his profession, he must pass a State examination.

ADULT EDUCATION

Several philanthropic societies, such as the Società Umanitaria, are interested in providing both general and technical courses for the cultural development and technical improvement of adults and adolescents.

The Ministry of Labour also has an extensive training programme for youth and adults in semi-skilled occupations *(addestreamento professionale)*.

Several of the universities have set up arrangements for part-time study but such courses do not usually lead to the full qualification of *dottore*.

REFORMS

On 24 July 1962, a commission headed by Professor Giuseppe Ermini was set up to study the development of public education in Italy. The most important proposals relating to vocationa

and technical education are a new type of institution, *scuola professionale*, to give a 2-year full-time course of education training for skilled workers; and university studies to be divided into three cycles: (a) 2-3 years to give a diploma qualification; (b) a total of 5 years for the *laurea* qualification, as at present; and (c) further studies to gain the *dottorato di ricerca* level. The first university-level diploma would, in technical studies, be closely connected with the training and education of higher technicians *(tecnici intermedi superiori)*. A proposal has also been made for the foundation of a national 'board or institute or centre responsible for vocational training' *(ente, instituto, o centro, per la formazione professionale)*, such board to be responsible to a committee.

THE NETHERLANDS

ADMINISTRATION

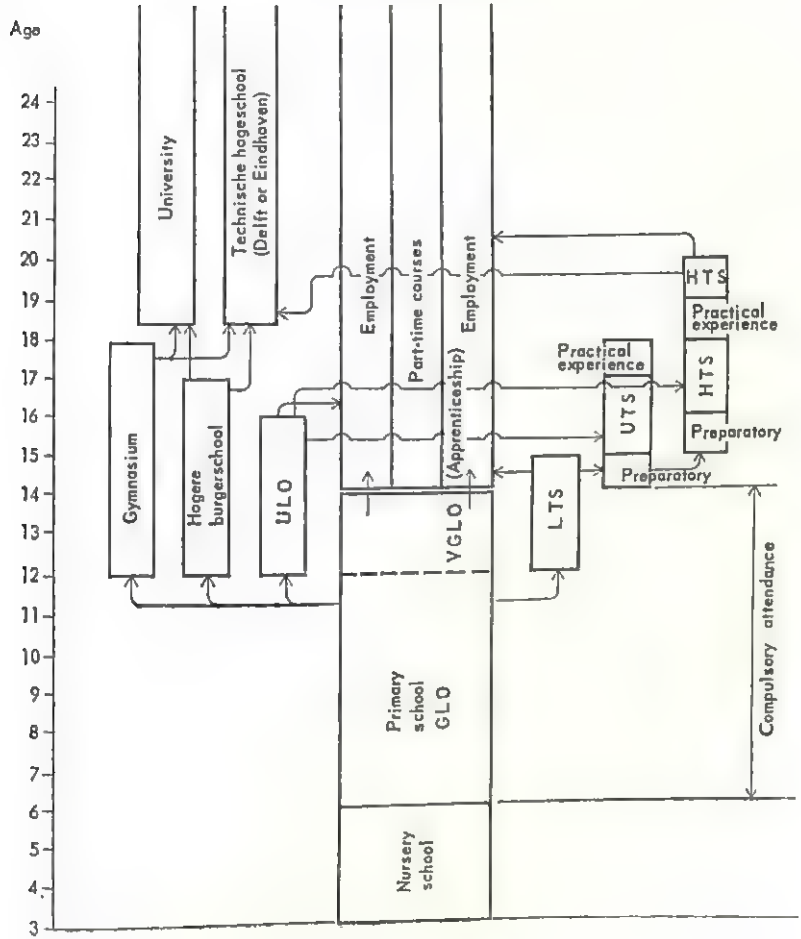
The Ministry of Education and Sciences is responsible for the national system of education. The Minister and the State Secretary of Education and Sciences are served by two directors-general. One is responsible for higher education and sciences—for university work—and the other for the five departments dealing with other levels and types of education.

The most characteristic feature of Netherlands education is the large attendance in privately founded schools. However, these schools are inspected, controlled and usually entirely susbsidized by the State. They are differentiated as Catholic, Protestant or secular. School attendance is compulsory for 8 years after the age of 6 or 7. Approximately 70 per cent of attendance is in 'private' and 30 per cent in public schools.

PRIMARY EDUCATION

The primary phase *(gewoon lager onderwijs)* lasts 6 years, after which the pupil may go on to secondary education, the selection being made *inter alia* by an entrance examination. A reform now pending may modify this. If the pupil fails, he may continue for 2 or more years in elementary education *(voortgezet gewoon lager onderwijs)* and then enter employment, possibly as an apprentice.

The Netherlands



SECONDARY EDUCATION

The main units of secondary education are, at present, as follows:

1. The *gymnasium*, giving a 6-year course, the first 4 years of which are the same for all pupils and which then divides into two streams: (a) emphasis on classical languages, and (b) emphasis on mathematics and sciences.
2. The *hogere burgerschool (HBS)*, offering a 5-year course, with a 3-year common curriculum, followed by 2 years' specialization in languages and commercial studies, or in mathematics and science.
3. The *lyceum*, providing a 1-year (in some cases 2-year) course as preparation for community life.

Entrance to a university or a *technische hogeschool* (technological university) is possible from any of the above schools, depending on the diploma required for admission to the various courses.

The *middelbare meisjeschool (MMS)* for girls was designed to qualify them for entry to various specialized institutes of higher education, including those for teacher training, rather than to the university proper.

Secondary education is entirely free for the first 2 years, i.e., ages 12 to 14.

Uitgebreid lager onderwijs (ULO) (advanced primary education) belongs by character more to secondary education than to the primary category, and is particularly popular. The course, which is diversified in the highest grades, lasts 4 years and prepares for the middle level of employment especially. These schools are also a means of entrance to certain teacher-training colleges and to the technical schools *UTS* and *HTS* described below, giving diversified courses in the highest classes.

Proposals for a radical reform of education were outstanding bor several years, but were passed into law in 1963. This reform re-plans secondary education from the age of 12. The changes are twofold: a longer programme of secondary education prepares students for a university or *hogeschool*, or provides pre-employment technical education; a shorter programme trains skilled workers for middle-level employment. There now is, as far as possible, a first year with a standard curriculum, with transfers if necessary at the age of 13, and then a division into the various types cited.

The pre-university schools are now the *gymnasium*, *lyceum* and *athenaeum*. This last will replace the present pre-university functions of the *HBS*, and the *HBS* will then fulfil the pre-employment technical education option mentioned above.

Vocational and technical schools

In addition to the primary and secondary schools mentioned above, there are the following vocational and technical schools (see diagram):

1. The *lagere technische school (LTS)*. This type of school gives a 2-, 3- or 4-year course. It is, at present, being converted from the older 2-year type recruiting at 12 years 8 months to a newer 3-year form accepting candidates who have completed six grades of a primary school. Some trades require an extension year making 4 in all. This is a vocational school which gives pre-apprenticeship basic training, and continues to give some general education.
2. The *uitgebreid technische school (UTS)*. This provides a 2-year course with an additional year of supervised experience in industry. Entrance is direct, or through a preparatory class, and is largely from the *LTS* or *ULO* schools. With the grade of middle-level technician, the student passes directly to employment.
3. The *hogere technische school (HTS)*. This type of institution for training upper-middle to higher-level technicians provides a 4-year course including 1 supervised year in industry. The course includes subjects of cultural value, scientific background and technical specialization. Entrance is from a secondary school, or from the *ULO* or the *UTS*.

HIGHER EDUCATION

The university in the Netherlands is represented by three State foundations at Leyden, Groningen and Utrecht, a municipal university at Amsterdam, a Catholic university at Nijmegen, and a Calvinist foundation at Amsterdam. In addition, there are a number of specialized institutions of similar rank: the Schools of Economics in Rotterdam and Tilburg, the Agricultural University at Wageningen, the *technische hogeschool* (technological university) at Delft, another technological university founded in 1957 at Eindhoven, and a third in the Twente region near Enschede opened in 1964. On 15 September 1965 a commission was set up to advise the Minister of Education and Sciences on the establishment of a fourth technological university near Amsterdam.

The length of studies in these schools is not fixed, and the student is largely left free to determine his own period, but 5 to

7 years is common. Having passed the requirements, the student obtains the legally protected title of *ingenieur*.

ADULT EDUCATION

In addition to extension courses available through the universities, there exist a number of formative institutes designed to train young out-of-school boys, girls and adults. There are three formative institutes connected with national organizations: the National Foundation for Mater Amabilis Schools and other institutes giving partially formative education for girls, the National Curatorium Catholic Life Schools for boys and young men, and the National Vocational Training Centre.

It is possible to participate on a moderate scale for an uninterrupted period of some weeks in a boarding school providing his sort of education.

SWEDEN

ADMINISTRATION

The Department of Education and Ecclesiastical Affairs has responsibility for all public schools, both general and vocational. Until 1962, there were two separate boards under one minister, one for schools of general education *(skolöverstyrelsen)*, and another for vocational and technical education *(överstyrelsen för yrkesutbildning)*. These have since been combined to form one administration. Since 1958, regional school boards *(länskolnämd)* in the 24 counties and municipal boards in the larger cities have exercised local control.

Whilst deriving a great deal of its form and methods from the past, the present structure of Swedish education was remodelled by the important Education Reform Act of 1962 which became law in July of that year. According to the provisions of that act, the 9-year comprehensive school, the *grundskola*, with required attendance from 7 to 16 years of age, is to replace all other school types in that age group. It is intended that the transition be completed by 1972.

PRIMARY EDUCATION

The comprehensive school (grundskola)

The first 6 years, comprising the lower and middle sections (*lågstadium* and *mellanstadium*), have the same curriculum for all pupils and the study of English commences in the 'fourth form' at about 11 years of age. In the higher section, the *högstadium*, optional variations of curriculum are available for seven or eight periods per week. In the eighth class, all pupils receive three weeks of vocational guidance. In the last year, or ninth class, there are nine distinct 'lines' arranged in five general groupings, each group excepting the first having two variants: one, more academic; the other, more practical. These variants are as follows: (a) general academic, preparation for entry to the gymnasium, 9g; (b) humanistic, 9h or 9a; (c) technical, 9t or 9mek; (d) commercial, 9m or 9ha; (e) social, 9s or 9ht.

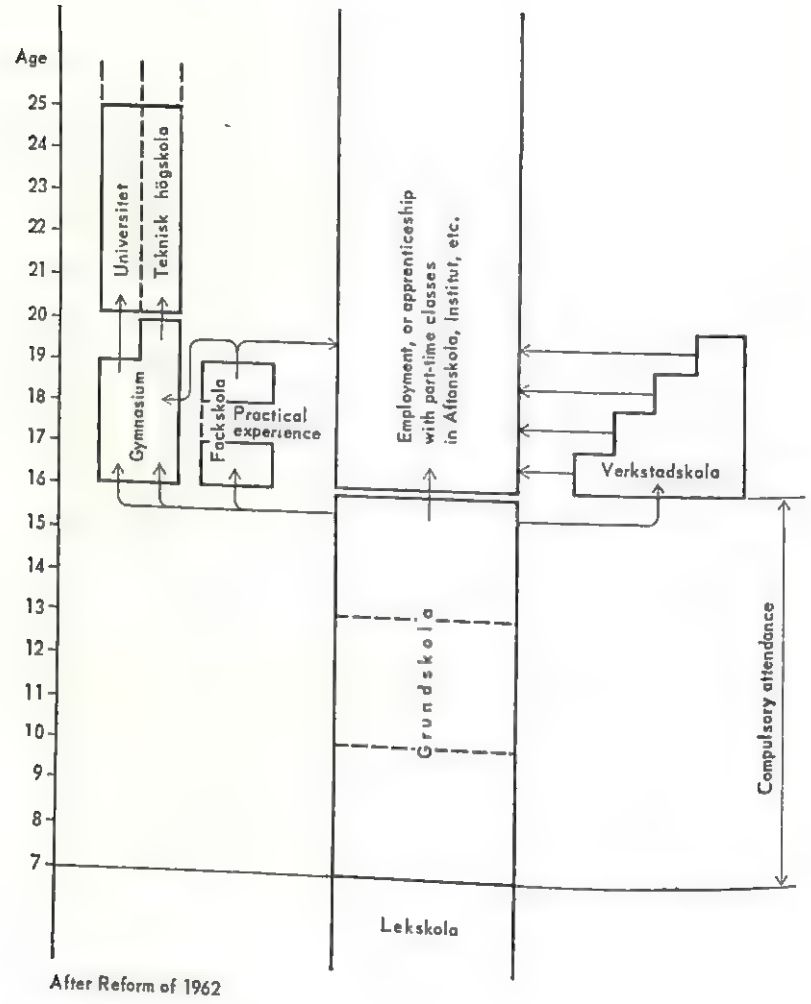
In the practical variants, i.e., 9a, 9mek, 9ha, 9ht, 22 of 35 class periods per week are spent in vocational studies. In the proposals for the reform of the *gymnasium*, all the more academic variations, i.e., 9g, 9h, 9t, 9m, 9s, would give access to the *gymnasium*.

SECONDARY EDUCATION

At present, only those who have successfully followed the first 'line' in the above list can apply for entrance to the *gymnasium*—the upper-level secondary school. Pupils in the other sections who wish to continue their studies above the age of 16 in full-time education are provided for in special *fackskolor*. These schools offer 2-year courses in one or more of the four sections: humanistic, technical, commercial, or the combined social and economic. The prototype of such study exists in various institutes, evening schools and commercial colleges. In addition, there is, at the age of 16, the possibility of entrance to the *verkstadskola* which trains for a skilled trade.

The pre-1963 structure inserted a 3-year *realskola* between the *folkskola* (the original compulsory school) and *gymnasium*, covering ages 13 to 16. Those who were not accepted by the *realskola* continued in the *folkskola* to the age of 14, 15 or 16, according to the legal school-leaving age for the area in which they lived. Beyond this the full-time *(verstadskola)* or part-time *(aftonskola)* gave a continuation of general education together with basic technical training. This older structure is still partly

Sweden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Teknisk högskola
Gymnasium
Fackskola
Practical experience
Employment, or apprenticeship with part-time classes in Aftonskola, Institut, etc.
Verkstadskola
Grundskola
Compulsory attendance
Lekskola
After Reform of 1962

operative, but the present transition to the comprehensive *grundskola* should be completed by 1972.

The Swedish *gymnasium* must not be confused with the German, Austrian or Dutch schools of the same name. The course usually lasts 3 years only (there are proposals to extend it to 4 years) and commences at the age of 16. The academic standards are high and the course culminates in the *studentexamen* necessary for admission to a university. There are three main options of study: classical, natural sciences and general.

There is a technical counterpart, the *tekniskt gymnasium*, also providing a 3-year course. This school gives the groundwork necessary to pass the *ingenjörsexamen* for acceptance to a technical university college.

The *tekniskt gymnasium* has a variation called the *tekniska fackskola* intended mainly for those with prior industrial experience. The programme is usually organized on a part-time basis, so that the duration of studies is equivalent to 2 years of full-time study. The qualification gained, *fackskoleingenjör*, does not of itself give access to a technical (or other) university, but by private study may now be equated to that of *ingenjörsexamen*.

Those who do not gain entrance to a *gymnasium*, a number which accounts for 80 per cent of the nation's youth, may continue their post-school studies in one of the many vocational training institutions.

The *verkstadskola*, over a period of 2, 3 or 4 years, gives training in a skilled trade, as well as continued general education. The pupil is given periods of practice employment in the trade selected during the school course and may be paid for the work he does.

Apprenticeship in a trade plus attendance at part-time classes is provided for also. The *teknisk aftonskola*, or technical evening school, provides a six-semester (3-year) course for the qualification *tekniker*, followed by a higher course lasting for four terms. Similar full-time courses are available at the *teknisk dag skola*, after at least six months' prior practical experience.

The *tekniskt institut*, enrolling at a slightly higher level, after school education to 16, provides a full-time course of three semesters for the qualification of *tekniker* and an additional two semesters for the qualification of *institutsingenjör*, which is at the senior technician level.

HIGHER EDUCATION

There are five universities in Sweden (at Uppsala, Lund, Göteborg, Stockholm, and since 1963, Umeå), several special institutes

usually specializing in a single subject *(fackhögskolor)*, and three technical institutes (the Royal Institute of Technology at Stockholm, the Chalmers Institute of Technology at Göteborg, and the new (1962) technical university at Lund).

Admission to any of the above universities or institutes usually requires that the candidate successfully pass the matriculating *studentexamen*, though requirements are relaxed or increased in accordance with the exigencies of the course.

The *kandidatexamen* (candidate degree) is the main first degree which is sought by most students. Although the course requirements can be completed in less time with variations depending upon the faculty, the usual time needed is about 4 years. The technological universities offer courses of a minimum of 4 years in length.

ADULT EDUCATION

In the field of general, cultural and adult education, Sweden has long been noted for its folk high schools *(folkhögskolor)*. Whilst cultural pursuits connected with good citizenship are the main aim of these schools, there has been in more recent years a movement to prepare some students for entrance to full-time vocational training institutions. There is a minimum age for entry of 18, though the average age is around 21. The schools operate mainly in the winter half of the year and give short residential courses which may be completed in subsequent years.

REFORMS

Following the Education Act of 1962, Royal Commissions were appointed to study possible reforms in the *gymnasium* and in the *fackskola*. Lengthy reports have been produced which are now under discussion.

For the *gymnasium*, a combination of the three types—general, commercial and technical—into one integrated organization with different programmes is proposed. The technical *gymnasium* will be extended to a 4-year programme with some transfers possible between *fackskola* and *gymnasium*. The *studentexamen* will be redesigned on a basis of internal tests, and the programme and examination will be controlled by assessors of the university and in the profession.

In the *fackskola*, a 2-year course will be available to all suitable leavers from the ninth year of the comprehensive school *(grundskola)*, or to those who have already acquired practical training.

For those coming directly from school, one year's practice would be advised between the first and second years. After completing the course, one can transfer to the gymnasium.

Plans for raising the school-leaving age to 16 are expected to be completed around 1970.

UNION OF SOVIET SOCIALIST REPUBLICS

ADMINISTRATION

Full account is taken, in the system of direction and administration of public education, of the economic, ethnic, linguistic and cultural characteristics of the national republics composing the U.S.S.R.

There is no All-Union Ministry of Education and education is entirely administered by the Councils of Ministers of the Union Republics through their respective ministries of education. Each ministry adapts its system to the republic's needs and has its own educational publishing houses which issue teaching aids, teaching manuals and literature on pedagogical, methodological and other subjects.[1]

All stages of education are free and are equally available to both sexes. In the institutions of specialized secondary education (*technikums*, etc.) and also in schools of higher education, up to 80 per cent of the students receive financial assistance from the State.

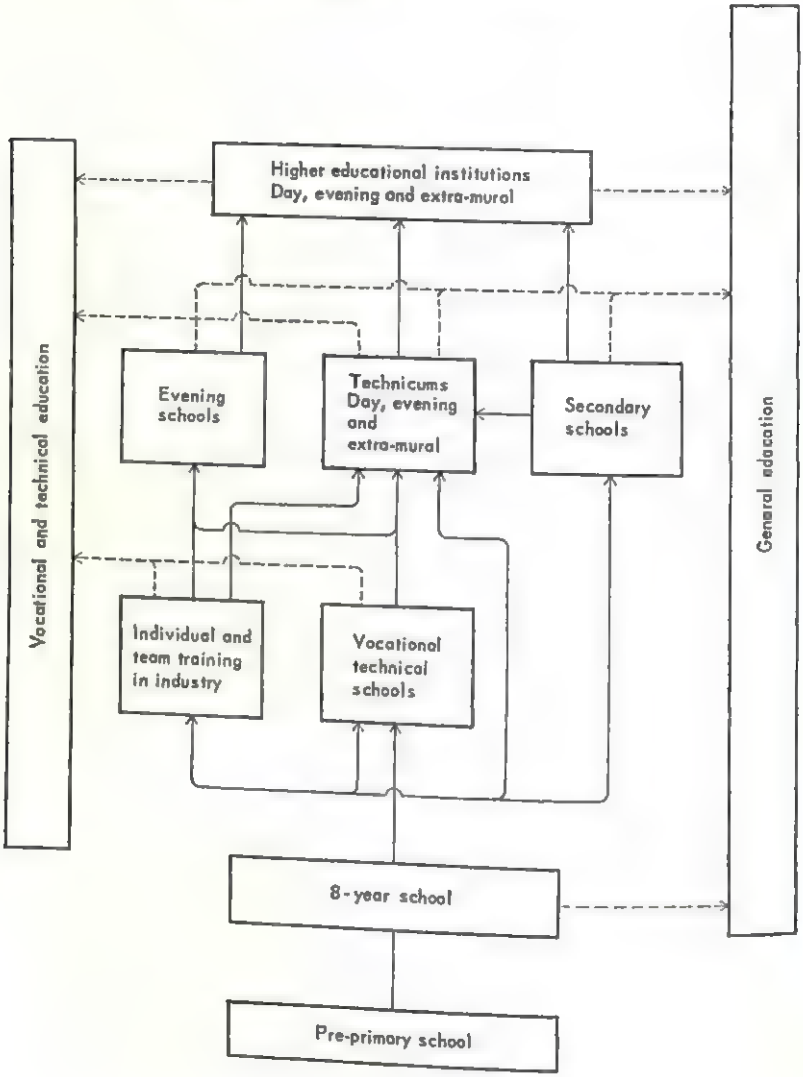
PRIMARY EDUCATION

The 8-year school

The 8-year school forms the first stage of compulsory education. It provides an 'incomplete' education for children of 7 to 15 years. The programme is general and serves as a base both for future scientific/mathematical training and for humanistic/academic studies. At the conclusion of this basic school, the young person may then select one of the following schools for further education:

1. *World Survey of Education.* Vol. III: *Secondary Education.* Paris, Unesco, 1961, pp. 1130 and 1132.

Union of Soviet Socialist Republics



a secondary school of general education, based on polytechnic principles; a specialized secondary school *(technicum)*; an evening, or alternating-shift school of general education, for those who are entering employment directly after the 8-year school; a vocational-technical school for skilled worker training.

SECONDARY EDUCATION

There are three main types of secondary schools.

1. The secondary school of general education. This school provides for the completion of general education in the sciences and the humanities. In the senior classes, the physical, aesthetic and moral education of the pupils is continued and strengthened. Polytechnical education gives an opportunity to master a profession quickly after graduation from secondary school, and to include pupils in productive labour in industry, collective farms and collective states.
2. The specialized secondary school (*technicum, college*, etc.). These schools prepare technician specialists of middle-level qualification for various branches of the nation's industry, commerce, and cultural work. The duration of study is normally between 3 and 4 years, though it occasionally runs to 5. Admission is from the 8-year school through an entrance examination. Completion of general secondary education is also assured in the specialized secondary school, for its diploma entitles the holder to apply for entry to any institution of higher education, provided he sits for the necessary entrance examination.

   For those already in employment, there is an increasing number of correspondence and night courses. In this case, the period of study is prolonged by a year.
3. Vocational-technical schools. Such schools prepare skilled workers for industry, construction, agriculture and public services, particularly in the manual trades. Students who have completed the 8-year school are accepted. In the urban schools, a period of 1 to 3 years is usual, whereas in the rural a duration of 1 to 2 years is more usual. During this period, instruction is given for the mastering of a selected trade, by practical instruction at school and in workshops, and in industry.

   Though a student cannot complete his secondary education in these schools, he can do so by going to a night or shift school after he has entered skilled employment. Suitable

pupils of vocational-technical schools may also apply for entrance to a *technicum*, or other form of specialized secondary establishment.

HIGHER EDUCATION

Higher education is available to young people in universities, polytechnics and specialized institutes, these having a period of study between 4 and 6 years. To be eligible for admission to such schools, the candidate must have a certificate of (full) secondary education, or a diploma of completion of specialized secondary education. In addition, there is an entrance examination. This level of education is also provided in external or evening forms, thus providing in even greater measure for the workers in productive industry.

ADULT EDUCATION

Evening or alternating shift schools are designed for youths and adults who are working but wish to complete their 10- to 11-year secondary education. Instruction is organized so that the student is not interrupted in his daily productive work. The duration of such courses, following 8-year schooling, is normally 3 years. Those who are at work in the first (morning) shift study in the evenings, and those who are at work in the second shift study in the mornings. This alternating arrangement gives rise to the name 'shift' school.

For those young people who, because of exceptional working hours, family conditions or place of residence, cannot attend such shift schools, there are also the 'external' forms of general secondary education.

Students in evening and correspondence courses are granted special concessions by the government. Those successfully following such courses receive one free day per week with wages paid, and in addition may optionally take one or two extra days, unpaid. Paid leave is granted for the period of the final examination. Completion of such a course gives the certificate of full secondary education, entitling the holder to apply for entry to an institution of higher education. Acceptance, as in other cases, is determined by the entrance examination.

UNITED KINGDOM

ADMINISTRATION

The four component parts of the United Kingdom—England Scotland, Wales and Northern Ireland—have separate systems of education. One Ministry of Education (recently reconstituted as the Department of Education and Science) has responsibility for England and Wales, with offices in London and Cardiff. A Department of Education has administrative control of education in Scotland with headquarters in Edinburgh, and the Northern Ireland Ministry of Education at Belfast has responsibility for that area. Only the system of education in England—current in Wales also, with minor exceptions—will be described here, but it is representative of the systems in other regions.

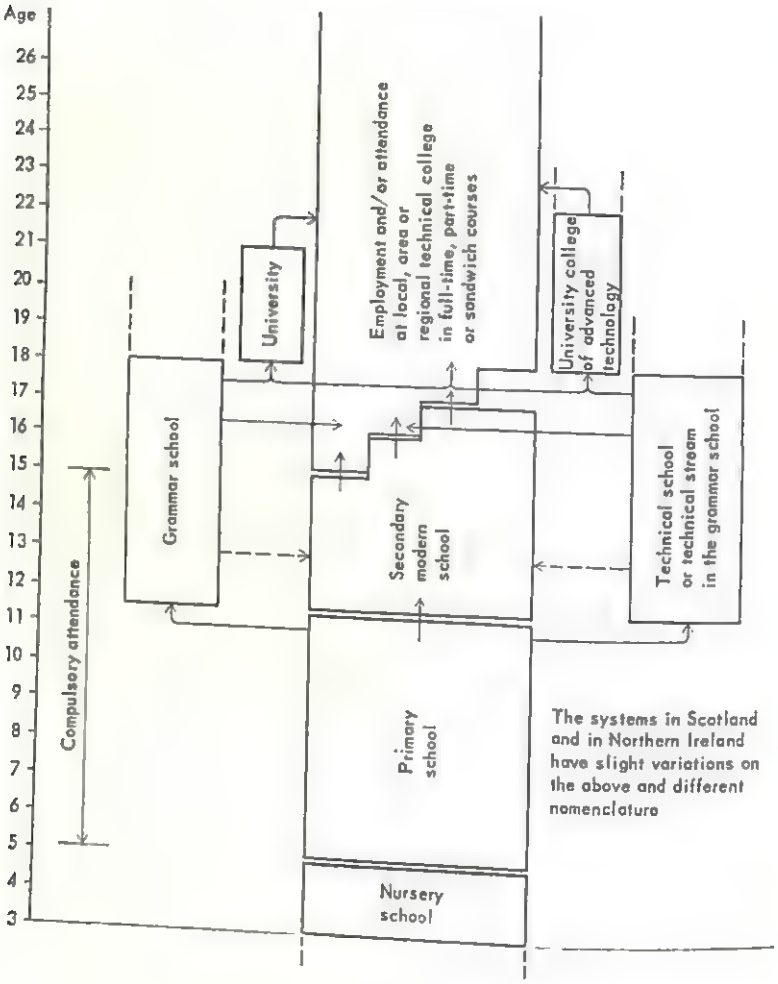
The Ministry of Education retains only general powers, administering through an executive body called the Local Education Authority. This is the County Borough Council and there are 146 of them in England and Wales. Acting through their education committees and within the framework of the various national education acts, these councils are free to control their own areas. This makes for considerable variation in practice between one district and another, particularly on the level of secondary education.

Attendance at school is compulsory from 5 to 15 years. The upper age is already authorized by Parliament to be raised to 16, though this proposal is not yet in effect.

PRIMARY EDUCATION

Primary education extends from the age of 5 to 11 or 12 and may take place in schools which are publicly maintained and controlled, or in privately organized establishments. At this point, there is in most areas a selection test at age 11/12 to determine, amongst other factors, the form of secondary education deemed to be most suitable for the pupil. The decision accords as far as possible with the parents' wishes. There are also privately formed and maintained secondary schools, called 'independent' schools.

United Kingdom



SECONDARY EDUCATION

There are four main types of secondary school:

1. The grammar school gives a complete secondary education, in many optional variations covering both classical and academic studies as well as scientific and modern courses. It is attended by approximately 20 per cent of the children in the relevant age group, these 20 per cent being selected by a competitive test, or in some areas by their primary-school record. A 5-year course terminates at about age 16 with the examination for the General Certificate of Education (GCE) at the level known as 'Ordinary'. A further one or two years of study leads to the 'Advanced' level in the same certificate. Both these examinations for Ordinary and Advanced certificates are on a 'single subject' basis—which means that the candidate may elect the number of subjects in which he wishes to be examined. There is thus no uniform, or national, secondary-school diploma of a type corresponding to the French *baccalauréat* or *Abitur* of the Federal Republic of Germany. A minimum of five passes is necessary for admission to a university.

   Not all the pupils of these schools proceed to universities, however, but may leave at the age of 16 or thereabouts, having acquired some subject passes in the GCE, to take up employment or apprenticeship, or to go into one of the forms of further education, as described below.

2. The technical school as a separate entity is diminishing as a significant factor in British education. The tendency in recent years has been to absorb technical studies into the grammar or comprehensive schools. Such schools which still exist—and they may provide technical, commercial or housecraft courses—usually have 5-year courses of which the first 2 years, 11 to 13, are devoted to general studies. The pupils of these schools are eligible to sit for the GCE in one variant of which a large number of technical and practical subject options are provided.

   Entrants to the universities from these schools are fewer than from the grammar schools, but there are many opportunities open to their pupils which, through the system of further education, either full-time or part-time, will achieve for them full professional status comparable with that obtainable through university study.

3. The secondary modern school accepts those students who do not find a place in a grammar or technical school, or whose parents do not wish them to be placed there. These

students are divided into groups according to ability. Not all pupils leave at the minimum age of 15, but may enter the preparatory programme for the GCE. There are several privately sponsored examinations, notably those for office and secretarial practice skills, which are available and which in most cases are approved by the Ministry of Education. A national programme at a lower level than the GCE has recently been authorized for the academic year 1965/66. It prepares for the degree known as the Certificate of Secondary Education.

Many secondary modern schools have developed courses of a semi-vocational nature which give a suitable preparation for apprenticeship, or other form of skill-training. Under no circumstances is such training a full form of apprenticeship; it is intended to be preparatory only and to supplement general education.

4. The comprehensive school has been adopted as a major policy in some areas and embraces the three school-types just described into one large unit of 2,000 to 4,000 pupils. This avoids selection at the age of 11/12 and facilitates any transfer made at a later age. Such schools do not impose a uniform curriculum upon all; instead, much importance is attached to finding the right course of study to develop each pupil's aptitudes.

The tendency to stay on at school after the minimum age of 15 is becoming more marked every year. In 1961-62, there were, of the total age group, in attendance full-time, 41 per cent between the ages of 15 and 16, 22 per cent between 16 and 17, and 11 per cent between 17 and 18.

Post-secondary school education

Holding a GCE which shows at least three 'O' levels and two 'A' level passes, the way is open to a university, or to a college of advanced technology.

On a slightly lower level, the regional or area technical college prepares the student for a 'Higher National Diploma' course which qualifies him as a higher technician. With four 'O' level passes, entrance is possible to an area or local technical college which provides a part-time 'National Certificate' course, concurrent with apprenticeship.

HIGHER EDUCATION

Higher education is provided in both universities and colleges of advanced technology (CAT). The latter, for purposes of administration and financial grant, will soon be regarded as university colleges, or universities, in their own right. In 1963, there were 31 universities and 10 colleges of advanced technology in Great Britain. These institutes had 118,000 and 10,300 enrolled full-time students, of whom 15 per cent and 100 per cent respectively were following technological studies.

Entrance to the university courses demands at least two 'A' level passes, in addition to three or more 'O' level passes in the GCE. Entrance to a college of advanced technology may be gained either by the same prior qualifications or by obtaining an Ordinary National Certificate with high passes (see Chapter III).

The university course lasts 3 or 4 years and awards the bachelor's degree: the course in the CAT is usually the 'sandwich' programme (alternating college study and works experience) and after 4 years the student is eligible for the qualification Diploma in Technology.

A recent (1963) report (Robbins Committee on Higher Education) recommends considerable reorganization and development of higher education in Britain. The colleges of advanced technology become universities and will henceforth grant degrees, whilst the larger technical colleges will also provide courses leading to degrees awarded by a newly constituted national body—the Council for National Academic Awards.

At present the percentage of the age group (men and women) entering all forms of higher education (university, teacher-training college and CAT) is 8.5 per cent full-time, and 6.6 per cent part-time, or a total of 15.1 per cent.

ADULT EDUCATION

From any school at the age of 15, various forms of full- and part-time preparatory courses are available at local technical colleges and evening schools, which lead into one of the courses described above.

The adult education service provides a system of evening classes, week-end schools and correspondence courses for those who, having completed their vocational qualifications, turn to literary, artistic, or general pursuits as a means of widening their horizons. Many voluntary groups, such as the Workers'

Educational Association or the Civil Service Educational Association, give much help to these programmes.

UNITED STATES OF AMERICA

ADMINISTRATION

Responsibility for education in the United States rests with the individual states and is not directly a federal matter. There exists, however, a Federal Office of Education, a part of the United States Department of Health, Education and Welfare, which exerts, mainly by means of grants and loans, considerable influence on education in the individual states, particularly in the areas of vocational and technical education.

Other federal departments, primarily the Veterans' Administration and the departments of agriculture and defence, also make large expenditures on special forms of education. In 1959 a total of $2,400 million was spent on education. Of this amount, $41 million out of the $738 million allocated by the Office of Education was spent specifically on vocational education. In the same year the combined federal and state expenditure on education was $27,300 million, or 5.41 per cent of the gross national product.

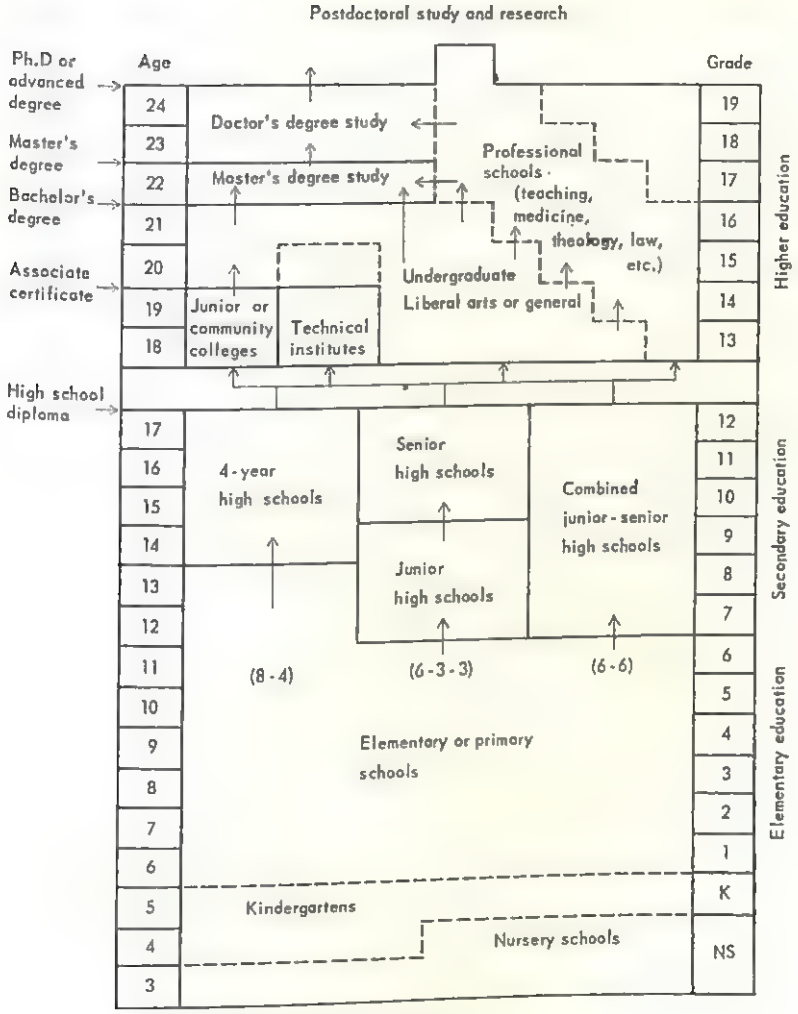
The individual state is the final legislative authority for education but day-to-day administrative control is the function of local school boards. Members of a school board may be elected (86 per cent) or appointed (14 per cent) but are usually independent of the local authority of the county or city. The districts—political sub-divisions of the state—are small: in 1959/60, there were still 21,900 districts having fewer than 50 children each but efforts are being made to group them into larger units. In 1957/58 the number of such school districts was 48,000.

PRIMARY AND SECONDARY EDUCATION

Attendance at school is compulsory from 6, 7 or 8 years until 16 17 or 18, varying according to state law. School attendance, from age 7 to 16, is now compulsory in two-thirds of the states but in practice 80 per cent of children remain until they are 18, that is, follow a course of 12 years' duration.

These 12 years may be divided into 8 years of primary and

United States



After Office of Education, OE-10005-62-A.

4 years of secondary (30 per cent of high schools are of this pattern), or 6 years of primary and 6 years of secondary. The majority of states have adopted the latter system. The 6-year secondary phase may be continuous in one high school, or 3 years in a junior high school, followed by 3 years in a senior high school.

SECONDARY EDUCATION

High schools are in general comprehensive, i.e., they admit all children in the district whatever their intellectual ability and offer general, technical and vocational courses. In the larger urban areas, a certain amount of selection may take place for placement in one of the following school-types:

1. General or college-preparatory high schools. These schools are the most common and, where selection takes place, will include the higher intelligence levels. A large percentage of the pupils enter college upon leaving the school.
2. Technical high schools. These schools include a moderately high percentage of the more capable students some of whom will enter college. However, they differ from the general high school cited above in that the programme of study is devoted to technical theory, training in manual skills being included as a complement.
3. Vocational high schools. Such schools used to take students of low intelligence and give them a vocational form of education to prepare them for the skilled trades. Half of the course was devoted to vocational pursuits, part practical and part theoretical and the remainder to general education. Today, the courses offered remain substantially the same as in earlier years, but many of these schools can now exercise a limited selection and may thus reject the less qualified applicants.

In each of these schools, a high school diploma is awarded at the age of 17/18 to those who have successfully completed their requirements and earned the necessary number of credits and grade-points.

From the high school the way is open to the 4-year college or university, or to the 2-year junior college, community college or technical institute. Graduates of the vocational high schools do not in general go on to gain college entry but proceed into apprenticeship or into skilled employment. Various forms of part-time and evening classes are available either for the continuation of general education or to supplement instruction relevant to the

daily employment of those enrolled, in accordance with apprenticeship regulations.

Under the National Defense Education Act of 1958, Title VIII, and the Vocational Education Act of 1963, many high schools have set up courses (a) in the last two years of normal schooling, i.e., 16-18, eleventh to twelfth, and (b) following the normal six years, i.e., at 18-20 in the thirteenth and fourteenth grades, in highly specialized programmes which train the student to the standard of technician. These are more fully described in Chapter III.

HIGHER EDUCATION

Higher education in the United States enrols in its first-year courses some 35 per cent of the total age group, and grants first degrees (bachelor or 4-year level) to 18 per cent.

There is no standard nomenclature, practice varying from state to state, but in general universities, liberal arts colleges, teachers' colleges, technological institutions, theological institutions and professional schools offer 4-year courses and award a bachelor's degree, whilst junior colleges, community colleges and technical institutes offer 2-year courses and award either the associate degree or other diploma. The total number of such institutions is over 2,000, of which approximately 600 are confined to 2-year courses only.

The minimum condition of entry is a high school diploma but 'credits' in certain specified subjects are usually required as well; they guarantee the length of study.

Part-time attendance, or sandwich (American co-operative) courses are known but are not widely practised, similarly there are correspondence courses, but few train students for entrance to college.

The master's degree, followed by a doctor's degree, is obtainable as the result of further study and/or research. Approximately 5 per cent of men and 2 per cent of women earn post-graduate degrees. The total annual number of master's degrees is over 400,000, of which 38,000 are in engineering or related fields.

ADULT EDUCATION

Adults and out-of-school youth are enabled and encouraged to participate in programmes organized at the federal, state and local

levels in public and private organizations. Literacy teaching is sponsored in all the states and territories primarily through the public school system. Courses in literacy are, however, but a small part of a much more comprehensive list of available courses.

Courses in primary and secondary education are usually offered at public schools in the evenings. Wide use is also made of correspondence teaching, university extension courses, the Armed Forces Institute, radio and television, etc. Known as 'high school academic education' (to distinguish them from vocational education programmes for adults), secondary-level courses are for adults who want a diploma, to develop a skill, or simply to continue their studies following completion of their primary education. Attendance is required for those who have enrolled. Scholarships and grants are available.

YUGOSLAVIA

ADMINISTRATION

The Socialist Federal Republic of Yugoslavia is a federation of six constituent republics: Bosnia and Herzegovina, Montenegro, Croatia, Macedonia, Slovenia and Serbia. The supreme organ of authority is the Federal Assembly. Through its six chambers, one for each republic, the Federal Assembly determines the national policy in all spheres of social life, which is carried out by the political executive organs. Together with the Federal Chamber, the Chamber of Education and Culture considers and decides on matters concerning education, science, the arts and other fields of culture, and passes laws and other acts in this domain.

The Federal Secretariat of Education and Culture concerns itself with the implementation of the adopted policy in the field of education and culture at the federal level. The responsible organs at the republican level and in other political-territorial units are the secretariats of the republics and the councils for education and culture respectively. Advisory services are provided by pedagogical institutions.

Following the Second World War essential changes were introduced in the system of education in Yugoslavia. These changes pertain to the ideological orientation of instruction, to the type, character and duration of the various forms of education and to the management of educational institutions and the financing of education.

The changes which have been brought about are regulated by laws and other acts, including the Law on Compulsory Seven-year Education (1945), the General Instruction on Schooling in General Education Schools (1952), the General Acts on Education (1958 and 1964), the General Law on Universities (1960); and the Federal Assembly's Resolution on the Training of Specialized Personnel (1960).

Education in all forms for the members of the national minorities is a component part of the school system in Yugoslavia. All national minorities in Yugoslavia have their own schools of general education with instruction in their mother tongue. There are also teacher-training schools in which subjects are taught in the Hungarian, Rumanian, Slovak, Squipetar and Turkish languages, and vocational schools with instruction in Italian, Hungarian, Squipetar and Turkish.

The financing of education is effected through educational funds set up by the political-territorial units. The distribution of fund resources is entrusted to the fund administrations. The federation sets the general principles governing the system of financing of education and the fund resources, making it possible for educational financing to keep pace with the increase of population and national income.

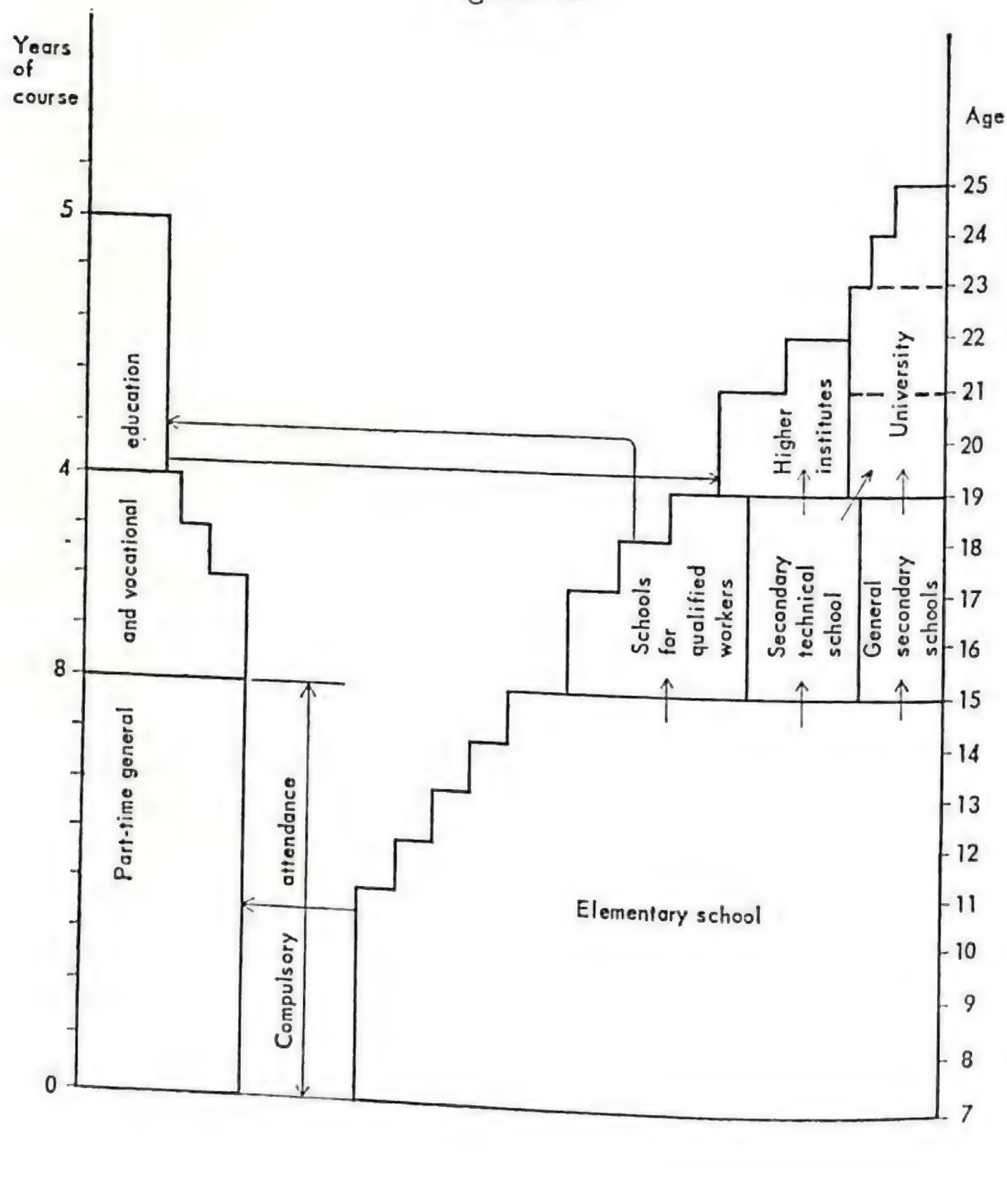
Religious schools in Yugoslavia are not embraced by the system of education. Their status is regulated by the Law on the Legal Status of Religious Communities.

In 1956 the system of public self-management was instituted in all forms of education. Pupils and students have their own organs of self-management. Up until 1964 school committees composed of distinguished social and public workers and members of the teaching staff and pupils' communities constituted the organs of self-management. Since 1964 the organs of self-management are the councils of the institutions composed of internal and external members (prominent public and social workers). The organs of pupils' self-management are the school community of pupils and the Student Union.

PRIMARY EDUCATION

Efforts aimed at the systematic elimination of inherited backwardness in the domain of education and culture were launched in 1945 by the introduction of compulsory 7-year education. Full 7-year education was carried out in different forms of organization, most frequently by adding 3 years of lower gymnasium

Yugoslavia


Years of course
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education
and vocational
Part-time general
attendance
Compulsory
Elementary school
Schools for qualified workers
Secondary technical school
General secondary schools
Higher institutes
University

to the 4 years of elementary education. The 1952/53 school year marked the introduction of compulsory 8-year education which was realized by the republics according to specific conditions and possibilities, either through the 8-year school as a complete organizational unit, or through 4- and 6-year elementary schools, i.e., smaller independent schools attached to central 8-year schools.

SECONDARY EDUCATION

The system of secondary general education also underwent structural changes. Classical and non-classical secondary schools and trade-preparatory schools continued to operate after the war as gymnasiums of various types. In accordance with the Law on Compulsory Seven-year Education, instruction in lower classes of gymnasiums lasted 3 years and in higher classes 5 years. With the change-over to compulsory 8-year education, gymnasium education was extended to 4 years. Since the 1960/61 school year, instruction in gymnasiums has been divided into two parts, a section of the curriculum common to all pupils and an optional part which begins in the second grade and offers courses in the social sciences and the languages, the natural sciences and mathematics and in classics and pedagogy. In the 1965/66 school year mathematics gymnasiums were introduced with a special educational structure beginning with the first grade.

Secondary education is also provided in vocational schools which include the following: schools for skilled workers, technical and equivalent schools, schools for the economy and public services, arts schools and teacher-training schools.

Schools for practical training and for apprentices enrol skilled workers. Apprentice schools provide general knowledge and vocational training in the enterprises and craftshops. In the schools for practical training students acquire both theoretical and practical knowledge in the profession they are training for.

Technical schools and other vocational schools at the secondary level prepare technical and other secondary vocational personnel for industry, agriculture, building and construction, transportation, commerce, the hotel trade, administrative-financial services, medical practice and the educational, cultural and social welfare services.

HIGHER EDUCATION

Two main types of institutes for higher education exist in Yugoslavia:

1. Colleges of higher education which developed rapidly after the war. There are today 139 such colleges as compared with only two before the war. The graduates of these schools are entitled to continue studies at the faculties in accordance with the statutes of these institutions. The number of advanced schools of faculty rank has risen from the pre-war number of 2 to 17, while the number of faculties has increased from 18 to 93.

   Colleges of higher education offer the following fields of study: political science, pedagogy, physical education, administration, economics, agriculture, engineering and art.
2. Universities of which there are five: Belgrade, Zagreb, Ljubljana, Sarajevo and Skopje, including 84 faculties in all. Among the technical faculties, there are six in electrical engineering, six in mechanical engineering and six in various technologies.

The status of the institutions of higher education is regulated by the General Law on Universities (1960). Pursuant to this law, instruction at the faculties may be divided into three levels, each of which is self-contained and at the same time mutually connected so as to enable any successful candidate to ascend the educational ladder. Apart from secondary-school graduates, all citizens over 18 years of age may enrol at Yugoslav faculties, provided they pass the necessary entrance examinations and thus prove their ability to follow the prescribed course of studies. Studies may be full-time or part-time.

ADULT EDUCATION

The evening schools for adult and part-time education now cover almost every part of the educational system including, for example, the upgrading of teachers themselves by the acquisition of higher qualifications. The illiteracy rate, estimated in 1945 at 48 per cent of the population, had by 1961 been reduced to 21 per cent.

Innovations in the system of education of specialized personnel were also introduced by the Resolution of the Federal Assembly in 1960. This Resolution deals with the vocational education of personnel in and out of schools as a uniform system which has to

be further adapted to the needs of the economy and the public services. The Resolution provides also for the introduction of new forms of vocational education, i.e., the establishment of school centres and centres for vocational education in working organizations.

This system has proved particularly useful in technical education where it enables young workers either to move to higher positions in their work, or to qualify for entry to technical education courses.

REFORMS

The status of vocational schools underwent the greatest changes after the completion of the reform in the educational system. The reform embraced the entire system from pre-school to university education as well as adult education. In 1958 the General Law on Education legalized the new system of education which had been in application since 1956 in accordance with the instructions of the Federal Assembly. The new system contributed to the further democratization of the previous system of secondary education, improved the educational and curriculum structure of vocational schools, and gave the possibility to pupils of vocational schools to continue studies under specific conditions at appropriate schools of higher education.

CHAPTER II

VOCATIONAL EDUCATION AND THE TRAINING OF THE SKILLED WORKER

'The term "skilled worker" applies to persons who have received a broad education and training in the exercise of a trade or craft in a particular field.'[1]

It is within this definition that there is the widest disparity between the methods used by the various countries of the world. In Belgium, for example, nearly all training for the skilled industrial trades is done in school, that is, in educational centres specially equipped to give both education and trade training on a practical and realistic basis. This sort of training may commence at an age as low as 12 years.

On the other hand, in countries such as the United Kingdom, the idea of such intensive vocational training during school years is viewed unfavourably and nearly all training for the skilled occupations takes place after school-leaving, or after the age of 15. Where trade subjects are taught in English technical secondary schools, it is as a medium of education and not with the object of training craftsmen. Apprentice training in such countries follows after school-leaving.

In other countries, for example, the Federal Republic of Germany, the student may leave his apprenticeship for one day per week to attend school, or general and basic technical education. In Sweden, the reverse system is in effect: release from the full-time practical training school is granted for short periods of work in the related industry.

Many other variations could be cited. In fact, the central responsibility for industrial training rests in one country with the Ministry of Labour and in another with the Ministry of Education, and in another with specific corporate bodies (e.g., the Netherlands stichtingen) having semi-statutory powers.

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1. Recommendation concerning technical and vocational education adopted by the General Conference of Unesco at its twelfth session, Paris, 1962, paragraph 2 (b). Text in English, French, Russian and Spanish.

One of the most important decisions for any country in vocational education is that between planning and the absence of planning. One by one, the countries of the world are being driven, because of economic factors, social pressures and industrial requirements for skilled labour, to accept the former system. Can a free choice exist for the individual in his chosen occupation, or must it be judiciously influenced or even directed by the statistical requirements of economic and industrial growth?

Unemployment, financial hardship, inability to finance the necessary training, inability to make the required grade in competitive tests, these 'natural causes' have long been accepted as part of the hazard of living. In fact, planification as a means of avoiding such afflictions tends to be resisted, particularly in those countries which have the strongest, or oldest, traditions of personal individual freedom.

Again, many hold that education must always be 'for its own sake'. A technical or vocational education, some would say, is a contradiction in terms: if it is vocational, it cannot be educational, and conversely if instruction is to be educational, it must not be vocational. This reasoning has excluded vocational education from the secondary schools of some countries, notably the Federal Republic of Germany and the United Kingdom.

A continually developing technology poses fundamental problems in social adaptation. Automation will provide as great a change of environment, and as much need for new and different forms of education and training, as did the changes many centuries ago from the economy of the migrant hunter to that of the farmer, and later the changes brought about by the Industrial Revolution.

What is it that we seek to achieve, or should seek to achieve in our education and training for the skilled trades in this era of rapid development? From the Middle Ages to the end of the eighteenth century, while the training of the apprentice was an introduction to the skill of the trade, it did not neglect the humanitarian aspect. The young apprentice assimilated not only trade techniques but the social customs and traditions of the guild, and later, as a master-craftsman, might have the opportunity of upholding these traditions. These traditions became so deeply embedded in the social fabric that in some countries—England and France are examples—the guilds still actively carry on these social customs, even though the actual trade has often disappeared, or the members of the guild have no functional part in that trade.

In those days the art of change was not taught, for the quicken-

ing effect of science and technology had not yet influenced the arts and crafts of the artisan world. Today, the art of change, and the graceful and profitable acceptance of change, must be taught, for we have now passed that point in time when a training given in adolescent years can last a lifetime. In many skilled trades, the particular skill and often the trade must be abandoned by the trainee.

Yet there is another side of vocational education which, by its nature, is almost unchanging, and that is its humanitarian aspect. The old questions of the Hellenic/Roman age concerning the nature of man, his destiny, his relation to his fellow citizens, the pursuit of happiness, the arts of governing and being governed, the lessons of history and the duties of family life, these things are as real and important now as they were 2,000 years ago.

The frantic pace of technology has made man bypass such questions, considering them to be less rewarding than the pursuits of technical developments. What is required, therefore, is to restore the true order of priority, to teach technics as a rapidly changing means of serving the ideals and aspirations of humanity. The class-room interpretation of this assertion must, of course, suit itself to the academic level of those taught—craftsman or technician, engineer or research worker.

The question now to be faced is whether apprenticeship in industry, education and training in schools, or a mixture of both, or whether an almost continuous process of short training and re-training should be the pattern of the future. The ultimate survival of manual skills with the onset of automation is in doubt. The 'harmonization' now being attempted by the European Economic Community in regard to vocational training needs to be a harmonization not only between one country and another, but also between the past and the future.

In this respect some of the newly developed countries may have the best prospects of success, for they are unfettered by the ties of tradition or by deep-seated social inhibitions. At the same time they have the strongest economic motives for the development of efficient systems of vocational training, for lacking these their industries cannot hope to compete in the world market.

It is with the interests of the emerging countries in mind that the following brief accounts of vocational training in 10 different countries, showing the systems now in use by some of the older nations, have been compiled. It is evident that such systems and methods are not necessarily suitable for direct export. Those whose duty it is to advise the newly industrialized country must take many factors into account before recommending wholesale

adoption of a particular system, for there is as yet no standard man—technical or otherwise.

CZECHOSLOVAKIA

The inculcation in the young of the skills and habits of thought and conduct appropriate to a productive society is the function and responsibility of all branches of secondary education, for even the general or academic secondary school contains a strong component of 'polytechnical education', including the subject 'fundamentals of production'. Those students who do not go on to a university—of which there are about one-half—take a shortened course of training to become either skilled workers, as described in this chapter, or technicians, as set out in Chapter III.

This chapter reviews the apprentice training centres and schools which offer 1- to 3-year courses for the usual skilled occupations in industry, commerce and in the health and social services.

'The primary goal in the education of apprentices is to qualify them for any of the hundreds of specializations and at the same time to broaden their general and polytechnical education. About two-thirds of all pupils leaving the 9-year school go in for apprentice training. In addition, other more advanced courses are open to graduates from the 12-year secondary schools who do not wish to continue either at a university or at a short-term vocational school (e.g., courses in precision mechanics, optics, aircraft industry, etc.). Their period of apprentice training may be reduced by one-half, as compared with pupils who have completed only the 9-year school.

'Apprentice trainees gain their qualifications as future skilled workers at "apprentice training centres" administered by industrial enterprises. These are integral educational units which provide specialized training, the teaching of both special and general subjects, as well as extra-curricular activities. Smaller factories and enterprises that do not have the resources to set up apprentice training centres as a complete educational unit arrange for technical training and after-work activities in "workshop training centres" on suitable factory premises, while instruction in both specialized and general subjects is provided by "apprentice schools" administered by the district national committees. Alternatively, where a particular enterprise is unable to provide schooling for its own required number of young skilled workers, it may request assistance from a similar factory or enterprise where there

is an apprentice or workshop training centre. While some apprentice training centres are residential, particularly those specializing in mining, metallurgy and the building trades, most of them are attended by trainees from the locality or neighbouring districts.'[1]

Some specimen curricula are displayed in Appendix II for the trades of mechanic and agricultural mechanic. In these curricula it will be seen that approximately half the weekly study is devoted to subjects of general and cultural education, making it possible for the able student to proceed further in both general and technical education and gain higher qualifications.

Apprentice training is thus industry based either entirely in the apprentice training centre or partly in the workshop training centre coupled with attendance at an apprentice school for the complementary educational subjects. The big apprentice training centres conduct courses for the skilled worker level of qualification and for continued general and vocational education as will be more fully described in the next chapter.

Such developments in the scope and purpose of the apprentice training centres was confirmed and legalized in the Act of 15 December 1960. Section 8, clause 1, of that act reads: 'Apprentice training centres shall provide for apprentice trainees technical training, secondary general and vocational education and out-of-school and out-of-work education. Apprentice schools shall provide secondary general and vocational education for apprentice trainees and, under given conditions, out-of-school education.'[2]

The teaching in these centres is performed by three different kinds of staff. The best of the factory's skilled workers are entrusted with the specialized practical training and are given opportunities for improving their abilities in this respect. The theoretical technical subjects may at present be taught by graduates of 4-year technical schools (discussed in Chapter III) whilst the general cultural subjects may be handled by those educated in the 4-year teacher-training institutes. The last two categories are intended to be replaced by university graduates.

The pupils at these centres receive an allowance in the first year when they are in training for basic skills. Wages on an ascending scale are paid during subsequent years. In the third year their training is on productive work in a factory. There is a similar transition in the proportion of time spent between education and

1. Stanislav Vodinsky, *Education in Czechoslovakia*. 2nd ed. Prague, Orbis, 1963. 80 pp. (The Czechoslovakia series, no. 6.) Translated from the Czech by Jarmila Milner and Ian Milner.
2. op. cit.

training. In the first and second years, lasting 40 to 46 weeks, approximately three days of each week are spent in the classroom and three in the workshop. In the third year this changes to two and four respectively.

The schedule of classification of these centres and schools shows 15 main divisions: mining occupations; metallurgical trades; chemical trades; machine tool and metal operatives; electrical trades; building trades; building materials, ceramics, etc.; timber trades; printing and lithography; textile occupations; tanning trades; food processing trades; agriculture and forestry; transport and communications; commerce and retail distribution.

Each one of these divisions has many sub-divisions: mining has 8, machine tool and metal trades has 45. Some of the occupations are closely defined, e.g., milling-machine operator, mechanic for machines used in ready-made clothing industry, brickmaker. The period of training is shortened to 2 years in some trades but in general it is 3 years for those coming from the 9-year schools, and varies from 1 year to 2 years for those who have completed their secondary education over the full 12-year period.

In any case the object is not solely to train skilled workers, but to set many off on a long educational adventure which for some will end in university qualification. To that end the 'secondary schools for workers' were established in 1959/60. The preamble to the 1960 Act states: 'A characteristic feature of the new Education Act is that it sets up a unified system of institutions catering to the education and upbringing of socialist man. As opposed to the former education acts, its range is not confined solely to children and young people, but concerns the whole nation, giving each and every citizen a wide range of possibilities of extending his education either after his working hours, or by interrupting his employment.'[1] Such possibilities will be further described in Chapter III.

FRANCE

The training of the skilled worker in France may be achieved in several ways, chief among which are the three following: (a) in school, i.e., full-time in specially designed centres, formerly called *centres d'apprentissage* and now firmly incorporated into the general

1. op. cit.

education system as *collèges d'enseignement technique*; (b) in industry, as an apprentice under contract, together with attendance at part-time classes, the *cours professionnels*; and (c) in small-scale crafts—*artisanat*—under the aegis of the Chambre des Métiers, the national organization overseeing the welfare of this branch of national activity.

The standards reached, and qualification awarded by examination, are the same for (a) and (b), that is the CAP *(certificat d'aptitude professionnelle)*, although it is claimed that the pass rate is higher for those prepared by system (a). The apprentice under (c) takes a different examination known as the *examen de fin d'apprentissage artisanal* (EFA), testing his basic knowledge necessary for the master-craftsman in a small trade.

THE 'COLLEGE D'ENSEIGNEMENT TECHNIQUE'

Dating from their legal foundation in 1945, the *centres d'apprentissage* offer a 3-year full-time course, which gives a combination of training and education in approximately equal amounts of time. Appendix II gives an example of such a programme.

The Educational Reform of 1959 provided for the continuation of these centres, re-named *collèges d'enseignement technique*, and instigated a 1-year preliminary course to bridge the gap from 13 to 14 years after leaving the *cycle d'observation*. The changes in the structure of French education formulated in 1962 provide for entry at age 15 with the consequent shortening of the course to 2 years following the *cycle d'orientation* of the first cycle of secondary education covering ages 13 to 15. The effect will be to increase [illegible] great improvement in view of the large numbers now refused entry. In theory entry is available to all [illegible] entry. In theory entry is [illegible] places is an entrance examination [illegible] places in all [illegible] examination [illegible] there are now 410 such schools comprising 330,000 pupils. They form one of the four [illegible] parts of the second cycle of secondary education and provide training for entry to indus-trial, commercial, social and administrative occupations as a qualified and skilled worker. Under the fourth economic plan (1962-65) with the provisions made for 1970/71, the number attending these centres is planned to rise from 220,000 to 406,000. At least 20 per cent of the relevant age group is to be oriented towards these centres.

The practical training is carried out as far as possible on

productive work of a realistic nature, sometimes including public services (e.g., hotel work, dyeing and pressing of clothes, boot and shoe repair, machine tool construction). The educational part of the curriculum pays particular attention to the social aspects of industry, to the aesthetic phases of design and to physical education.

Hostels are provided for pupils living at a distance from the large cities. Organized holiday centres are also provided.

The teaching staff are drawn from industry and from educational institutions. There are special pedagogic training colleges—the *écoles normales nationales de l'enseignement professionnel*—for the training of teachers in these schools.

Whilst most of the *collèges d'enseignement technique* are publicly maintained and controlled, there are several which are run by large firms, by industrial groupings, or by chambers of commerce. They are sometimes subsidized from public funds after the standards have been certified.

APPRENTICESHIP IN INDUSTRY

Apprenticeship takes place after leaving school at 14, though occasionally later, according to the specification laid down by each individual firm. Each applicant must produce a certificate to the effect that he has been advised by the careers guidance service *(orientation professionnelle)*. The period of contract is usually 3 years with an optional extended period giving more extensive training. By the Act of 25 July 1919 (Loi Astier) attendance at part-time classes by all persons under 18 years employed in industry or commerce became compulsory. An attendance of a minimum of [illegible] per year was required [illegible] the employers had [illegible] organized [illegible] practicable in the [illegible] had been drawn [illegible] whenever practicable. These could be held [illegible] different bodies [illegible] observed. These [illegible] different bodies [illegible] years sometimes [illegible] commerce, [illegible] become associations [illegible] industrial firms [illegible] centres de formation [illegible] pupils were in attendance resulting in 63,000 examination entries and 32,000 passes in either the CAP or EFA qualification. The number of contracts was estimated in 1960 at 270,000 of which 128,000 were in large-scale industry and the rest in small-scale crafts.

The Ministry of Labour is responsible for the placement and training conditions of apprentices in industry whilst the Ministry

of Education, assisted by consulting committees composed of industrial representatives and educators, sets the standard and content of the CAP examination.

In recent years attempts have been made to prepare students for the CAP by correspondence courses combined with short full-time attendance for the practical instruction.

Family allowances continue until the age of 17 and sometimes beyond, and there is a quarterly annual medical check.

'APPRENTISSAGE ARTISANAL'

This programme *(artisanat)* trains workers for the small-scale trades and artistic crafts, and is aimed more especially at the apprentice who intends to become a master-craftsman himself. *Artisanat* is usually defined as the kind of enterprise employing no more than five persons including apprentices. A large proportion of French enterprises come within this definition.

By a decree of July 1925 the Chambre de Métiers was set up on a county basis with a central office in Paris. A special bureau is maintained for its work of technical education. A small tax is levied on master-craftsmen to support this administration. Apprentice contracts are registered, attendance at the *cours professionnels* by the apprentice is checked and where part-time attendance is impractical other methods such as correspondence courses and mobile workshops are substituted.

THE APPRENTICE TAX

Beginning in 1925, a *taxe d'apprentissage* was levied on industry and commerce as a percentage of the total wages bill to provide in part for the work of technical education. Alternatively a firm may offset this tax by paying defined expenses in connexion with apprentice training, schools, instructors and day-release attendance, or by direct financial support of a local technical institution.

PROFESSIONAL UPGRADING

Further qualification and study is provided for by *cours de perfectionnement* leading after two years or more study to the *brevet professionnel*, an advanced craft certificate of high standing for

trade purposes. The equivalent qualification in the *artisanat* branch is the *brevet de maîtrise*. In some areas the *cours de promotion du travail* leads the skilled worker through suitable preparatory courses to technician level qualification.

The holder of a *brevet professionnel* with 5 years' practical experience may also be considered for entry to a teacher-training college preparing him as a teacher of practical subjects in a *collège d'enseignement technique*.

FEDERAL REPUBLIC OF GERMANY

Although in recent years some training of the skilled worker has been conducted in full-time schools *(Berufsfachschulen)*, nearly 90 per cent of the training necessary for supplying national industrial needs is done by and within industry itself under carefully regulated conditions.

The boy or girl leaving the *Volksschule* at age 14 or 15 may seek a position as an apprentice *(Lehrling)* in a full 3-year or $3\frac{1}{2}$-year course of training, or as a trainee *(Anlernling)* during a shorter 1- or 2-year period. Sixty per cent of the students leaving the *Volksschule* become apprentices of this sort.

Such apprentice training is under the general supervision of the Federal Ministry of Economics, in association with the Ministry of Labour, and is codified under specific regulations *(Ordnungsmittel für die betriebliche Berufserziehung)*. These regulations include a specification of the necessary aptitudes *(Eignungsanforderungen)*, an analysis and description of the skills involved *(Berufsbild)*, examination tests and a scheme of training. The *Berufsbild*, specifying the qualification to be reached during training, is made an integral part of the contract of apprenticeship.

Regional administration of apprenticeship training is conducted by the Chamber of Industry and Commerce (Industrie- und Handelskammer) or by the Chamber of Crafts (Handwerkskammer) for the *artisanat* sector, i.e., small trades, crafts and private businesses.

Every enterprise and master-craftsman must, by law, be a subscribing member of one of these bodies. The former maintains a central office at Bonn (Arbeitsstelle für betriebliche Berufsausbildung) for the documentation of the different trades and for the dissemination of this information to local individual firms. A similar organization exists for the *artisanat* sector.

The contracts of apprenticeship signed between firm or master-craftsman, parent and apprentice are registered with the

appropriate *Kammer*, which undertakes the responsibility of ensuring that the training given by the firm is satisfactory.

The number of different training schemes include approximately 500 *Lehrberufe* and 160 *Anlernberufe* involving 1.2 million and 50,000 apprentices and trainees respectively in 1959. The industrial sector has 124 *Lehr-* and 15 *Anlernberufe* trades, the commercial 31 and 5, and the *artisanat* 124 and 15. The schemes are constantly under review, some being cancelled and others added.

During the period of apprenticeship, the boy or girl attends the *Berufsschule* compulsorily to the age of 18, or to the end of apprenticeship, for one day per week. The instruction combines general education and basic technical theory. Practical training is not given except as a demonstration of technical studies, e.g., machine-tool operation or materials testing. Some sample curricula are given in Appendix II. The *Berufsschule* studies, whilst compulsory, are not a direct part of the final end-of-apprenticeship examination *(Lehrabschlussprüfung)* but of course play an important role in developing general and technical competence. Such education is free of charge. The examination is conducted within the firm under the regulations of the respective *Kammer*, and the successful apprentices gain their *Facharbeiterbrief* or *Gesellenbrief* respectively in industry, commerce or *artisanat*.

The larger firms maintain apprentice-training sections, and sometimes work-schools. In recent years efforts have been made to widen the scope of training from one narrowly prescribed occupation (e.g., turner) to a more comprehensive field. An extended period totalling $3\frac{1}{2}$ years is thus followed by many apprentices.

There is a higher qualification, *Meisterbrief*, which can be obtained after 5 years of practical experience and another examination. Some full or part-time facilities exist in works and in schools *(Gewerbeschulen, Fachschulen)* for the necessary practice and instruction.

For the more ambitious, one or more of the following educational opportunities may be taken.

APPRENTICESHIP IN SCHOOL

Berufsfachschule

Except in some commercial occupations, a complete apprenticeship in school—as in France—does not yet exist in the

Federal Republic of Germany. The *Berufsfachschule*, however, provides a 1- or 2-year full-time course of a pre-apprenticeship nature (Appendix II). The subsequent period of apprenticeship may be shortened by one-half of the duration of this school period. The apprentice starts with a firmer and wider basis of general and technical knowledge. Most of the *Berufsfachschulen* are free.

Berufsaufbauschule

The apprentice who during his first year of apprenticeship and attendance at *Berufsschule* shows himself to be capable may join a supplementary evening course known as the *Berufsaufbauschule*. This usually involves attendance for four evenings per week over six or seven semesters, from 3 to $3\frac{1}{2}$ years, depending on progress. The object is twofold: the extension of general education for those who left school at the age of 14/15, and the foundation for later higher technical study. The apprentice must complete four requirements to receive the award of a *Fachschulreife:* (a) completion of *Berufsschule;* (b) attendance and examinations in the *Aufbauschule;* (c) completion of apprenticeship, and examination; (d) extended practical training in associated crafts for at least half a year. This important certificate entitles the student to apply to a *Höhere Fachschule* or *Ingenieurschule* for technician training. The *Berufsaufbauschule* includes subjects such as German, English, algebra, geometry, physics and chemistry for the first four semesters, and later provides studies in technical subjects and mechanical drawing.

As another alternative, the apprentice may postpone attendance at an *Aufbauschule* until after the end of his apprenticeship and extended training and join a full-time day *Aufbauschule* of two to three semesters. In each case the length of attendance at an *Aufbauschule* may be decreased if apprenticeship has been preceded by 1 or 2 years in a *Berufsfachschule*.

The *Fachschulreife* gained in this way may be used for entry to an institute which prepares the student for university entrance *(Institut zur Erlangung der Hochschulreife)*. After a 2-year course the degree *Reifezeugnis* permits entry to a university or *Technische Hochschule*.

The apprentice stage is thus, for an ambitious student, the first phase only of a long academic programme which does not require the *Abitur* or grammar school qualification. Hence this programme has become known as *Der Zweite Bildungsweg*—the second educational route.

The number of apprentices following this programme, although increasing year by year, is still only 10 per cent of the whole. Efforts to improve this proportion have been mainly concerned with replacing the strenuous evening study of 12 hours per week by day attendance either full or part-time. The proportion of those who precede their apprenticeship by attendance at a *Berufsfachschule* is thus steadily increasing. Moreover, it is now being realized that, especially in *Länder* where the leaving age is still 14, an extended general education through the *Berufsfachschule* is a necessity if polyvalent skill and associated technical knowledge is to keep pace with the ever-changing and ever-increasing demands of modern industry and commerce.

For the ambitious apprentice with lesser academic ability, the day or evening *Fachschulen* provide instruction which reaches the lower technician *(Techniker)* level as described in Chapter III.

On the commercial side, there are the *Höhere Berufsfachschulen* (higher pre-employment schools) which usually require *Realschul* education, or extended primary education, for admission. A 2-year course prepares the student for entry to commercial apprenticeship or to employment. Exemption is thus obtained from the work done in the *Berufsaufbauschule* and a shortened apprenticeship is allowed.

ITALY

The training of the skilled worker *(operaio qualificato)* has hitherto taken place mainly in full-time institutions designed for the purpose, but in recent years there has been a rapid growth of on-the-job apprenticeship training in industry.

Previous to the Educational Reform Act of 1963, the *scuola di avviamento professionale* provided a 3-year course covering ages 11 to 14, with a vocational bias and some workshop training. Even shorter *corsi di avviamento professionale* of 1 or 2 years, starting at age 11, provided some degree of vocational preparation. These programmes, clearly inconsistent with the forward development of Italian education, have now, since the Reform of 1963, been incorporated into the new *scuola media unica* described in Chapter I. None of this education, before the age of 14, could have been recognized as equivalent to the full training for an end-of-apprenticeship qualification although past statistics have often indicated the contrary.

Because of the provisions of the Reform of 1963, any practical

or vocational bias in the *scuola media unica* will be for educational rather than for industrial reasons and the more serious vocational training will follow after the age of 14.

For many years the *scuola tecnica* gave a skilled worker 2 years' training with continuance of some general education following the *scuola di avviamento professionale*. Its aim was vocational training for a specific occupation rather than technical training for a range of occupations. The entry requirements were low and the *scuola tecnica* gave an unsatisfactory base for the continuation of higher technical studies. This type of institution reached its apogee in 1955/56 with a total enrolment combining public and private schools of 45,733 pupils.

Since that date the *scuola tecnica* has declined in favour of the better developed *istituto professionale* offering a 2-, 3- or 4-year course combining technical theory and workshop practice in courses designed not only to cover fully one specific occupation, but to extend the knowledge of the industry as a whole and of its related occupations. A specimen programme of studies is given in Appendix II. Such institutions have courses for the various occupations in industry, commerce, agriculture and occupations taking women exclusively.

From a modest 58 *istituti professionali* in 1953/54, the number in 1960/61 had risen to 295 with 66,858 enrolments, to 403 in 1962/63 and to 568 in 1965 with 1,630 local associated schools. Of the 568 institutions, 264 (47 per cent) are industrial, 107 (18 per cent) agricultural and 197 (35 per cent) for commerce and services.

In addition the reform of secondary education, after the first graduations from the *scuola media* in 1966, provides a sounder base for the *istituto professionale*, so that its 3- and 4-year courses will train students for the junior technician or foreman of industry instead of for the rank and file of skilled workers. Once again the needs of the basic skilled operatives must be considered, and one of the provisions of the Ermini report of 1962 *(La Relazione Ermini)* was its proposal for a new institution aptly to be named *scuola professionale*. Its purpose was to combine the advantage of the 2-year short course of the former *scuola tecnica* with the better financial and educational provisions of the *istituto professionale*, and thus secure a short but adequate preparation for the basic skilled level as an operative or a skilled worker. Only by this means, the report claimed, could the output of trained workers from the educational system be raised from the present 25,000 to a projected 200,000 within the next 10 years.

However, a powerful new movement under the aegis of the

Ministry of Labour is now making a substantial contribution through organized training within industry. This training may take the form of works-schools, similar to the *scuola tecnica* or the *istituto professionale*, in which case they conform largely to the pattern of the State institutions of that kind. An alternative is the familiar practical training in the shops combined with associated technical instruction in an educational institution.

A large volume of high quality full- and part-time vocational training has also developed under the care of various philanthropic bodies. The work of the Salesian Institutes and the Società Umanitarià in Milan are outstanding.

The Ministry of Labour and Social Security has wide powers resulting from the legislation in 1955. The growth since that date is strikingly revealed in the table below.

Year	Apprentices registered			Number attending classes	
	Artisanat	Industry and commerce	Total	Session	Enrolment
1956	163 400	191 911	355 311	1956-57	85 944
1957	211 252	251 120	466 372	1957-58	121 351
1958	267 049	288 941	555 990	1958-59	254 244
1959	305 354	322 150	627 504	1959-60	299 989
1960	341 152	363 567	704 719	1960-61	389 536

The total number (in 1960) of 704,719 compared with the total attending *scuola tecnica* or *istituto professionale* in that year (99,120) shows that the vast majority of skilled workers are now being trained in industry rather than in educational establishments.

Under the 1955 legislation all apprentices must be engaged through the employment offices of the Ministry of Labour. Firms having less than 10 employees may nominate their apprentices individually but the larger firms may choose only 25 per cent of their apprentice intake. There are the usual conditions of health, age limits (14 to 20), hours, wages and holidays. The duration of apprenticeship must not exceed 5 years and is usually 3 years.

The part-time classes are free of charge up to the level of the basic qualification; thereafter, fees may be charged. The apprentice is bound by his contract to attend them.

The content, weekly hours and general curriculum are decided jointly by the Ministry of Labour and by the Ministry of Education. The courses are either given on industrial premises,

where employers are encouraged to arrange them, or are organized by local educational institutions at the instigation of the Ministry of Labour, which subsidizes all or part of the cost.

Apprentices who are over 18 and have had at least 2 years' training are entitled to submit themselves to be tested. In the first instance this test is administered by the employer who, if he awards the qualification of occupational competence, reports this award to the local office of the Ministry of Labour. Apprentices who fail may appeal and take a test under the control of a commission presided over by an inspector of the Ministry of Labour.

Ten years have revealed some of the weaknesses of the legislation, especially in relation to the quality of the associated part-time courses. There has been too large a variation in entry standards. It is clear that small classes have to be grouped, mixing both trades and levels of attainment. In sparsely populated districts, it is difficult to organize classes on a part-time basis, owing to travel difficulties. This is particularly so in the southern areas. Finally, there has been great difficulty in finding suitable staff who are able to co-ordinate theoretical and practical instruction.

Various solutions to these problems have been proposed. The problem has been reduced by the Ministry of Labour, which has set up its own full- or part-time training centres *(centri di addestramento)* in regions lacking in facilities or where there is considerable industrial demand for skilled labour. Some of these centres primarily train adults who have passed the normal age span (14 to 20) for apprenticeship contract.

The Act of 1949 gave the Ministry of Labour extensive powers for the training and re-training of unemployed persons. Accelerated training courses for intending emigrants as well as courses for the preparation of industrial manpower in southern Italy are also organized.

In addition to the figures given for normal adolescent apprenticeship, the following table includes special forms of training for the unemployed, for adults and for special purposes.

Year	Juveniles		Unemployed	
	Courses	Attendance	Courses	Attendance
1951/52	1 813	54 540	4 674	134 115
1954/55	3 420	87 414	3 291	83 267
1957/58	9 545	197 610	2 065	42 495
1960/61	12 867	280 303	1 089	29 299

Unemployed persons under 40 who are unwilling to attend these courses cease to be eligible for unemployment compensation. Those who do attend receive a small daily grant in addition to unemployment pay at the normal rate.

The recent measures for industrial training in Italy have been made necessary by the present rapid development of industry. Coming after the damaging effects of the Second World War upon the educational system, they have closely paralleled the needs of the newly emergent countries in Asia and Africa.

The ILO International Centre for Advanced Technical and Vocational Training opened in 1965 at Turin in northern Italy. It will provide much useful data on which to base future training schemes and hence facilitate the training of instructors for all developing countries.

THE NETHERLANDS

In the Netherlands, the training of the skilled worker, especially for industry, is almost entirely a post-war development. Both the 'in-school' system *(lagere technische school)* and the industrial apprenticeship *(leerlingstelsel)* methods of training are current, and both have shown vigorous growth in recent years. The 'in-school' training, however, is not regarded as equal to apprenticeship, but is considered as preparation for later training in industry usually with the remission of 1 year of the normal apprenticeship period for the trade. In this respect the *lagere technische school* is more like the *Berufsschule* of the Federal Republic of Germany than the French *collège d'enseignement technique* or the Italian *istituto professionale.*

The technical school system has three levels: *lagere technische school (LTS), uitgebreid technische school (UTS)* and *hogere technische school (HTS).* The first of these is discussed in this chapter and the two others, *UTS* and *HTS,* are taken up in Chapter III.

The *LTS* was formerly a trade school paying greater attention to vocational training for a specific occupation than to the general and technical development of the pupil in preparing him for fields as varied as manufacturing, industry and building. The balance has now been redressed, by extending the course to 3 years, the first year of which is largely general education with a basic introduction to various crafts, trades and skills on a non-specialized basis. After this first year, the pupil makes a provisional choice, commences workshop practice in the trade selected, together with related subjects and confirms his choice

as he passes into the third year. Though difficult, he may change his speciality for another. A specimen time-table is given in Appendix II.

Approximately a third of all pupils not selected for a senior secondary school pass into some form of the *lagere technische* school. These schools used to concentrate in the engineering and building trades but in recent years development has taken place in other occupations (the automobile industry, electrical engineering, furniture trades, printing, textiles, coke-oven practice) so that an output corresponding to industrial need has been achieved. There are also some works schools *(bedrijfscholen)* of the same type but the total enrolment is only 3 per cent of the whole.

An extension of this basic trades-training may take place in the *uitgebreid lager nijverheidsonderwijs scholen)* (schools for extended industrial education) but this variation is now declining in favour of the fourth year in the *LTS.*

Similar provision, *nijverheidsonderwijs voor meisjes,* is made on a more limited front for girls in housecraft and agricultural housecraft schools, at three levels: lower, intermediate and upper. Some of the courses are also provided on an afternoon or evening attendance basis, and most are closely connected with a specific occupation, e.g., child nurse, horticulture or social assistant.

The organization of apprenticeship training in industry is unique. Each industry is invited to set up under the general and legal provisions of the Vocational Training Act its own foundation *(stichting)* for training purposes. The composition of the members of these boards must represent the six main interests involved: employers (Catholic, Protestant and Lay) and employees (of the same three denominations).

Standard training requirements for each identifiable trade are then drawn up by expert committees, and observers appointed by the foundation make visits to ensure that such training is being followed. An examination is set at the end of the 2- or 3-year apprenticeship period. Though this examination is not required by law, it is customary and a successful completion is the usual requirement for obtaining employment in a skilled trade.

Concurrent technical instruction is organized at educational establishments which the apprentice must attend for an average of four evenings per week. This technical instruction is provided at the cost of the Ministry of Education, and the end-of-apprenticeship examination, while conducted by the industrial foundation concerned, is also, together with all other apprenticeship regulations, under the general control and supervision of that

ministry alone. The Ministry of Labour on the other hand organizes the training and re-training of adults.

The cost of this apprentice training, when conscientiously carried out, is high. The State pays a *per capita* subsidy to the employer for each apprentice but this is usually only a very small proportion of the total cost of training. The State also subsidizes the entire basic administrative costs of the foundation.

On 31 December 1962, 64,564 apprentices, of whom 3,230 were girls, enrolled. Of these students, 38,633, including 159 girls, had entered apprenticeship after preliminary qualification in the *LTS* and the remaining 25,931, including 3,071 girls, had had no such previous training. From these figures, it will be seen that apprenticeship in the Netherlands is still largely adapted to boys, and that most of them now enter their industrial training after they have been given a basic theoretical and practical education by the lower technical school.

The number in 1962 completing their apprenticeship was 16,245, of whom 2,207 were girls. Of these 2,207 students, 1,704 were in the needle-trades, 273 in animal and poultry rearing, 137 in shoemaking and 93 in textiles.

The total number of registered apprentices (boys only) in 1962/63 was 54,321. Of these, 33,167 attended part-time day courses, 18,802 attended evening classes, 2,352 were in work-schools. This was the third year in which the day figures exceeded those for evening attendance and points up the success of the transition.

In 1960 there were 29 national foundations *(stichtingen)* for industrial training. Some are large and operate over an extensive industrial complex, e.g., metal industries *(bemetel)*, building, textiles; others are more specialized in their field of application, e.g., bookbinding, lithography, plastering.

On leaving the *LTS* the more ambitious and intelligent boy or girl may seek entry to a *UTS (uitgebreid technische school* or extended technical school). This is usually done through a link or preparatory class *(schakelklas)* which gives a basis of general education in 1 year, including languages, mathematics and science. Technician training may be added in later years, as described in Chapter III.

It will be noted from the above description that the occupational training of the boy or girl in the Netherlands often starts at the age of 12/13 in the *LTS* and at 14/15 in industrial training. The reform of education now awaiting implementation will generalize the training of the 12-13 age group so that transfers from extended elementary education *(lager algemeen voortgezet*

onderwijs, lavo) may take place into the *LTS* at the age of 13, i.e., at the beginning of the eighth year. Even so, specifically vocational education commences one or two years earlier than in France or Italy (post-1963). However, such vocational education is preparatory and must be followed by industrial apprenticeship and so the comparison is not a close one. The qualifying age of 17 is similar to that in other Western European countries.

SWEDEN

Vocational training in Sweden has had the benefit in post-war years of much co-operative planning and action on the part not only of the public authorities but particularly of the representatives of industry. In 1944, the Swedish Employers' Confederation and the Federation of Trade Unions established the Joint Vocational Training Council (Arbetsmarknadens Yrkesråd) under the administration of the Labour Market organization. The functions of this council are: (a) to review vocational training needs; (b) to take measures for its expansion and development; (c) to supervise the joint committees for the individual industries; (d) to initiate policy in regard to vocational training; and (e) to maintain contacts with the relevant public and private bodies.

On the educational side, the various vocational schools described below are the responsibility of the Board of Vocational Training (Overstyrelsen för Yrkesutbildning) which is now an integral part of the general Board of Education in the ministry (Ecklesiastikdepartmentet). On this board, representatives of the Labour Market organization, of industry and of commerce act jointly with educational and official representatives.

Whilst this board has the duty of controlling, inspecting and, to some extent, standardizing vocational education throughout Sweden, the initiative in setting up new vocational schools lies with the municipalities, or, in some cases, with individual industries, or with large industrial groupings.

The basic vocational school is the *verkstadskola* (workshop school). This institution, in a 2- or 3-year full-time course starting at the age of 15/16, gives a complete training preparatory to employment, possibly after a year's probationary period, as a skilled worker. It has several forms which combine theoretical instruction and practical training partly in school and partly on industrial premises.

The normal type is the municipal workshop school *(kommunala*

verstadskolor) of which there are some 220 providing for about 15,000 pupils (about 7 per cent of the relevant age group). The curriculum involves 30 class hours of practical training and 12 class hours of theoretical instruction. Some of the students have had a good full-time general education up to the age of 16. All have at least continued to the age of 15, so the course emphasizes skilled manual training at this stage. Consequently about 30 out of 42 class hours per week are devoted to workshop practice.

Tuition is free and the pupil receives a small grant in addition. The school charges for productive work done by the pupils, whether at the school or by contract on outside building sites or in a manufacturing works.

Since 1926 practical tests have been organized in some trades, these being held in the presence of examiners appointed by the craft guilds. The journeyman's certificate *(gesällbrev)* is awarded on the basis of these examinations.

Another type is the central workshop school *(centrala verkstadskolor)* of which some 35 schools enrol about 7,000 pupils. These schools are especially maintained for the rural areas, and nearly always have a hostel attached for pupil-residence. Thus pupils in any one trade can be collected from a wide-enough area to give satisfactory class sizes. The number of different trades taught is large including some that are appropriate to rural or coastal areas, e.g., boat-building, automobile and tractor mechanics, agricultural mechanics, as well as the usual mechanical, electrical and building trades. The hostel accommodation is paid for by the pupil or by his parents.

However, the type of workshop school which has deservedly gained much attention in recent years is the 'works integrated' school *(inbyggda skola)*. In this school there is an agreement between a *verkstadskola* and an industrial firm, according to which the firm provides the practical instruction subsidized by the State and the school provides the theoretical instruction. The proportion of theoretical to practical instruction is the same as in the normal programme, where the schools do their own practical training. The pupils receive a normal apprenticeship wage both for the time spent in the firm and for the time in school.

The firm must have an instructor of sufficient training and experience to be approved by the National Board for Vocational Education and the subsidy is a fixed amount for a group of 8 to 16 pupils. Exceptionally, a particular group may be taken on by other small firms who then also share the subsidy.

The first year of such training is often spent full-time in the workshop school itself, thus acquiring a basic training before industrial production work begins. The pupil is entirely supervised by the school, whether he be actually in school or at the factory.

Apprentices' courses are provided mainly on an evening basis for those who are already employed in the trade, as apprentice, trainee or employee and they are intended to provide the theoretical and practical complement to their industrial life. Such courses usually last 2 years and occupy six to nine hours per week. Trade technology, economics and trade legislation are included in the course. Specialized courses of a duration ranging from one $4\frac{1}{2}$-month period to 2 years provide a study in depth of the trade concerned, or of a related trade. Handicrafts and small industry *(artisanat)* are confronted with problems in Sweden as elsewhere. Formerly, nearly all vocational training was obtained on the job under a master-apprentice contract running for 3 to 5 years. This system for a variety of reasons is tending to decline in favour of the special vocational schools, public and private, described above as 'workshop schools'. A craftsman who has already graduated from his apprenticeship training may obtain more advanced training by attending short courses at the Swedish Government Institute for Handicrafts (Statens Hantverksinstitut) at Stockholm. To be eligible for admission, applicants must possess qualifications equivalent at least to the journeyman's test *(gesällbrev)* as well as have some years of practical experience. The courses usually last one to two weeks full-time and enrol 10 to 30 applicants.

The institute also acts in an advisory capacity in technical and economic matters and conducts research and experimental work in its laboratories and workshops.

In addition to the courses mentioned, the student, having acquired a basic education in the comprehensive school and leaving there at 15/16 years of age, may continue his studies in advanced technical school *(kommunala tekniska skolor)* either by evening attendance or by returning to full-time study. These studies train him for entry to a technical gymnasium or qualify him for the *tekniker* level. The duration of the course is $1\frac{1}{2}$ years with full-time attendance, or 3 years, taking the evening courses. These studies will be further described in Chapter III which deals with the qualification for technicians.

UNION OF SOVIET SOCIALIST REPUBLICS

The fundamental principles for vocational and technical education were formulated in the first years of the Soviet State by its founder V. I. Lenin, in the following terms: vocational education must be sufficiently broad and deeply founded to avoid the character of artisan craft-skill; it must be well integrated with general and polytechnic knowledge and education; it must be ever ready to respond to the growing demands of progress in engineering and science; and it must be based upon unity between instruction and productive labour, upon youth participation in the national struggle for building a new society.

One of the first decrees of the Soviet State was to require young people between 15 and 18 working in the national economy to attend school on six occasions per week for two hours each time. The first form of vocational education was the 'school club', but this became detached from the realities of production, and soon reverted to a merely recreational form.

The next attempt at improvement was the *FZU* school (school of factory training) where young people were trained as skilled workers for any particular enterprise. The curriculum of these *FZU* schools included not only industrial (productive) training but a number of general, technical, and special technical theoretical subjects.

In the early years, the *FZU* schools had to accept entrants with only 3 or 4 years of general schooling, and consequently the curriculum had to include many courses of a general educational nature. As the quality and length of general education improved, the emphasis was laid on vocational training for which the schools were intended. But though schools trained workers well, they did so in inadequate numbers and in very limited specialities. In general, they prepared for the needs or partial needs of one enterprise while omitting the needs of other enterprises which did not, or could not, support such a school.

To resolve such a problem, the State system of vocational schools (labour reserves) was established in 1940 with a view to preparing youth, in both urban and rural communities, for all enterprises requiring workers of medium skill. This system of vocational schools was developed in close relation with the changing demands of the nation's economy, as reflected in the types of schools—trade schools, railway, building, metallurgical, agricultural schools, etc. Each school had its own characteristics regarding level of qualifications, branch of industry for which preparation was provided, age and previous education of trainees.

For nearly 20 years of its existence the system of labour reserve schools has trained 11.5 million workers, who formed the framework of skilled labour in leading branches of the national economy.

The present stage in the development of vocational and technical education was laid down by the law 'On strengthening the ties between school and life and the further development of the system of national education', adopted by the Supreme Soviet in December 1958.

In response, a new and unified type of technical school was founded—the *PTU (professialnal' no-techničeskie učiliščа)* for both urban and rural communities. These schools are now replacing all other types of technical schools, irrespective of the various government departments under which they were formerly administered. The new *PTU* schools provide students who have completed the 8-year school with high-grade training as skilled workers for all branches of the national economy, including those branches for which such regular training was not provided before. The *PTU* schools specialize in and co-operate closely with different branches of production. Each school is attached to one or more near-by industries, collective and State farms, building sites or transport organizations. These enterprises provide the site of the practical training in production.

The duration of training is determined by the needs of the specific occupations and varies from 1 to 3 years in urban centres, and from 1 to 2 years in rural centres. The State Committee for Vocational and Technical Education has drawn up a list of specialities, giving those which are suitable for *PTU* training and the length of the course. This list includes more than 2,000 such specialized occupations.

The educational process in these schools has four main components: industrial (practical) work which takes 60-70 per cent of the total time, theoretical instruction, physical education and out-of-school activities (the curriculum of the 3-year course used for the training of instrument fitters is summarized in Appendix II). The content of general education and of general technical knowledge is determined by the demands of the occupation concerned.

In addition to the strictly vocational *PTU* programmes, there are also 4-year vocational schools which combine the vocational training of the 3-year schools with general education to enable the trainee to finish his secondary general education.

Moreover, trades requiring a training time of less than 1,000 hours, i.e., about six months, are at present being trained directly in industry itself. Similarly, the re-training of workers whose

trades have become out-moded, or the transfer-training for new trades of those engaged in related fields, is usually carried out by industrial enterprises.

The list of occupations, 6,000 in all, drawn up by the State Committee for Vocational Technical Education, also prescribes the duration of instruction necessary for each trade.

The training of the worker by an industrial enterprise is carried out by the methods of the so-called 'individual-and-team' training. In all cases, the two components—practical productive training and theoretical study—are necessary. Theoretical studies sometimes occasion a break from the continuity of productive employment (cf. Appendix II for a detailed description of the training of an electrical fitter under this programme). In this form of training, each trainee is on an instructional team, this team fulfilling a suitable programme of work in production or on building sites, etc., under the supervision of a well-qualified team instructor. The number of trainees per team is determined by their trade requirements and by the conditions of production.

For the theoretical studies, the trainees group or re-group to a number not less than 10, each group being composed of one vocation or several related vocations. The theoretical instruction, like the practical, is taught during regular work hours which vary according to age and trade. In situations where a group for theoretical studies cannot be formed, the trainees study alone but under the guidance of one of the production engineers working in the same enterprise. Theoretical courses are organized especially for those occupations where the mastering of skills is dependent upon a grasp of the theoretical aspects or on more diverse experience than the trainee is likely to obtain on his job.

All such training, determined by the State Committee for Vocational and Technical Education, is supervised and controlled by local committees for training.

Apart from the basic training of new workers in industrial enterprises there is also widespread development of courses for the upgrading of existing workers, both technically and culturally.

In 1964 the vocational schools turned out 943,000 skilled workers whilst in industry 3,332,000 new workers were trained and 6,938,000 underwent upgrading.

UNITED KINGDOM

Until 1964 the training of the skilled worker was under no form of statutory control but was the entire responsibility of industry and in most instances of individual firms.

In some industries joint organizations representing both employers and trade unions had been formed and had drawn up collective agreements concerning apprenticeship schemes. These schemes were published and disseminated with the co-operation of the Ministry of Labour and the Youth Employment Offices, but they had no legal authority for enforcement.

The schemes, all subsequent to a report on the subject in 1945, did, however, stimulate the 'day-release system' according to which apprentices up to the age of 18 years are given one day per week in working hours, wages paid, to attend a technical college and follow the kind of courses described below.

The period of apprenticeship in such schemes was normally 5 years beginning at the age of 16. At the termination of this period the young man (or woman) 'comes out of his time' and obtains full adult wages regardless of whether or not he has passed any qualifying examination given by the industry or the college concerned. The completion of the 5-year period was the criterion of qualification rather than any compulsory trade test. Nonetheless, most apprentices studied for City and Guilds of London examinations and many succeeded in obtaining the Intermediate or Final grade which is described later. The percentage of those who passed, however, was somewhat low.

Schools such as the French *centres d'apprentissage*, which no longer exist, or the Italian *istituto professionale*, which gives full-time apprenticeship training, have not existed in Britain for half a century. Trade subjects are taught in secondary schools for educational rather than for occupational reasons.

In March 1964 an Act on the subject of industrial training empowered the State through the Ministry of Labour to promote and control many forms of industrial training and to maintain the standards for qualification. This was the first Parliamentary legislation on the subject of apprenticeship training since the Statute of Artificers in 1563, which was itself preceded by a similar statute in 1364.

Control is exercised and the necessary measures implemented not by the Ministry of Labour directly but by statutory boards which have powers over a defined industry or range of industrial activities. The members of these boards represent the employers, the trade unions, the educational and other interests concerned.

As of July 1965, trade boards had been set up for the following industries: construction, engineering, iron and steel, wool and textiles, shipbuilding, electricity, gas, water supply, and furniture and timber. Other industries have already or will be included.

It is as yet too early to specify the changes to be made but it is very probable that a shortened period of training will be adopted, probably 3 years, including a basic training period of 6 months or 1 year, either on industrial premises or in a college. The boards have power to tax all firms (except very small ones) in the industry concerned in order to finance their expenditure on training. The boards are authorized to reimburse costs and wages to firms undertaking satisfactory training of apprentices.

PRACTICAL TRAINING

With few exceptions all schemes of apprenticeship in Britain have relied upon the industrial workshop or a works training school for the major part of the skill-training component of the apprentice's instruction. Whilst the larger firms have excelled in providing facilities and staff for this purpose, the majority of firms, particularly those which would be classed as *artisanat* on the Continent, give training as part of the normal productive work under the supervision of a more skilled worker. In Britain no distinction is made between industrial apprenticeship and training in *artisanat.*

In 1958 the Industrial Training Council was established on a voluntary basis. It had representatives from the British Employers' Confederation, the Trades Union Congress and the State industries. In 1964 it was reconstituted as the Industrial Training Service and provides an advisory service on training which is available to any industry upon request. The council has also published several valuable booklets on apprenticeship problems. Other voluntary bodies like the Engineering Industries Group Apprenticeship organization sought to improve training by giving an apprentice the opportunity to gain a wider experience through the grouping of a number of firms.

Despite this effort and even after advice and encouragement from the 1958 National Joint Advisory Council (Carr Report), apprentice training was, as late as 1964, inadequate to meet present needs. The main reasons for this situation were as follows: the amount and quality of the training were left to the arbitrary decisions of a large number of firms; there was a compulsory test for qualification for only a few trades, and these tests rarely

affected wages; there was no adjustment of the financial burden between firms who did or did not carry out training schemes: and there was no body, organization or firm with any positive powers to make improvements.

It was with such deficiencies in mind that the Industrial Training Act of 1964 was passed. European practice was well studied by those who set out the detailed provisions of the act.

THE GENERAL AND TECHNICAL EDUCATION OF THE APPRENTICE

Up to the age of 18, one day per week release from work with full wages paid is the normal amount of time for the theoretical instruction of the apprentice. In some courses, one or more additional evenings may be added out of the pupils' leisure hours. Such release, however, is not obligatory and it is still common practice, especially in courses for commercial qualifications, for attendance to be only in the evenings.

A new system called 'block-release' is also rapidly coming into practice. In this scheme the apprentice is released from work for several weeks at a time. There may be two or more such periods in the year. In between these periods he must also attend college for one or two evenings a week to continue his progress throughout the year. Such block-release schemes usually give about 50 per cent more time per year than the one day per week, or three evenings per week system.

After leaving a secondary modern school (the lower level of secondary education) at the minimum age of 15, the student enrols as a part-time student at a 'local' technical college. The technical colleges of England and Wales are classified in four categories: local, area, regional and advanced. The student may choose one of two courses: (a) a craft course (see Appendix II) relevant to a skilled trade, permitting him to gain a Craft Certificate after 3 years, or an Advanced Certificate after 5 years; or (b) a general course (of which there are several varieties, e.g., engineering, science, construction, etc.) which lasts 2 years and combines practical work, basic science, mathematics and elementary technical theory.

The craft course combines practical instruction in trade practice with basic theory pertaining to such work. The practical instruction is intended to supplement the 4-day per week training in industry and not to relieve the employer of that duty. The examinations are set and conducted by the City and Guilds of

London Institute (CGLI). The advisory committees of this institute include employers and members of trade unions as well as educators. The council of the institute comprises members appointed by the Guilds and the City Corporation of London, many of these being corporate descendants of the mediaeval guilds.

The craft and more recently the technician qualifications awarded by the CGLI are well known and respected in the industries concerned, both in the United Kingdom and elsewhere in the British Commonwealth.

In general, however, wage agreements take little cognizance of these awards, and an apprenticeship is regarded as completed by time, rather than by examination. As a result, the percentage of skilled workers holding such certificates is low. The new statutory boards for training will, it is expected, make considerable changes in this respect.

The second option quoted—the general course—is the starting point in Britain of the second way for continued education. During the first year of the course, a careful diagnosis of each student's abilities is made, as the result of which he may be relegated to a craft course, as described above, transferred to a technician course or promoted to the second year, which leads on to higher technician courses (for these last two, cf. Chapter III). The general courses are also administered by the City and Guilds organization.

A pupil leaving school at 16 years with some subject passes at 'O' level in the General Certificate of Education may often be exempted from the first year of the general course, and if he has four or more subject-passes in the related subjects, he may be exempted from two years of the course. He is then eligible to enter directly upon a course for the National Certificate in engineering (or construction, or applied physics, etc.; cf. Chapter III).

Thus from whatever type of school the apprentice has come and to whatever type of qualification he aspires, he is assessed and advised during these early years and finally placed on a line of study suitable to his abilities. An apprenticeship in a firm providing good training facilities, combined with part-time education, has led many industrial apprentices to craft qualification, others to technician status, some to higher technician levels, and a few (4 per cent) to full professional engineer qualification. This programme has been continually adapted and improved since it first went into effect in 1921 and is being initiated in many countries.

UNITED STATES OF AMERICA

The first federal legislation dealing with the practical education of the industrial classes was the Morrill Act of 1862 by which colleges were endowed to 'teach such branches of learning as are related to agriculture and the mechanic arts'. As is common practice with educational institutions such colleges rapidly climbed the academic ladder and soon granted degrees considered to be the equivalent of a degree from a university. The result was that skilled trades were again without organized training.

In 1917, however, the Smith-Hughes Act became law and on this act the present American vocational school system was built. It provided federal subsidy, matching the local state expenditure for organized full- or part-time pre-college-level classes in agriculture, home economics, industrial and later commercial pursuits. Nearly half a century has since gone by and in 1960 nearly 4 million pupils between the ages of 15 and 18 were attending vocational schools or vocational classes in general schools. Of these, however, only 1 million were attending courses classed under trades and industry, the remainder being in courses for agriculture, distributive trades, home economics and nursing. Of these 1 million, only 300,000 were attending by day, the remainder being in employment and attending evening classes or other part-time courses.

In 1937 the Fitzgerald or National Apprenticeship Act was passed with the intention of encouraging organized apprenticeship schemes, to promote high standards, and to set up federal and state apprenticeship committees. By 1961 there were 160,000 apprentices registered under and conforming to the provisions of this act.

INDUSTRIAL TRAINING

The Fitzgerald Act sets the following general standards of apprenticeship: (a) minimum age 16; (b) a schedule of training to be drawn up; (c) wages to average 50 per cent of the full adult rate; (d) related instruction at school of a minimum 144 hours per year. It also defines the apprenticeship agreement and its registration by the State.

In practice apprenticeship in the United States differs considerably from that in Europe. In the United States apprenticeship usually begins at the age of 18 and lasts 4 years. The wages paid are

substantial and productive work is expected. The related instruction of 144 hours per year is concerned more with trade practice and technology than with education and such courses rarely ever lead to the higher qualifications of technician or of graduate engineer. Two examples of apprenticeship schemes are given in Appendix II.

The United States apprenticeship system includes only selected trades. According to the Fitzgerald Act, an apprenticeable occupation is one which customarily has been learned through experience on the job, requires 2 or more years to learn, and requires related instruction to supplement experience. The greater selectivity of American apprenticeship registration should be kept in mind when comparing statistics with other countries.

There is a very high drop-out rate. In the period 1941-53 the registrations totalled 687,605 and of these 328,332 gave up before completion of their course. In 1961 the cancellations amounted to more than 50 per cent of new registrations.

The related instruction in school or college takes place in the evenings since there is practically no day-release in the United States, although evening attendance sometimes counts as overtime, and is paid accordingly.

The training programmes drawn up in accordance with the requirements of the local joint apprenticeship committee are a good feature of the United States system and do much to enlarge the experience in the occupation.

The apprentices, being a good deal older than their European counterparts, are anxious to earn all the money they can, for many are married. Hence, many of them work long hours of overtime or accept other part-time employment in the evenings.

A few schemes of apprenticeship offer local variations permitting the apprentice to take the journeyman's test in his trade and, if successful, to receive full wages while continuing his 4-year period of apprenticeship.

In some occupations, such as typography, there is a departure from the past in that points, or credits, are awarded for specified units of experience, as specified in the training schedule; when such points total up to the required figure and the trade test is completed, apprenticeship is considered as finished, regardless of the amount of time served. This is probably the most realistic and progressive of present-day apprenticeship methods.

THE MANPOWER DEVELOPMENT AND TRAINING ACT OF 1962

By 1962 it was clear that the volume of apprentice and other skilled worker training in the United States was below that of Europe and the Soviet Union. The problems of labour redistribution consequent upon automation and also of unemployment for school drop-outs made it eminently desirable to organize short, intensive forms of training preparing for direct entry to skilled employment. Such courses were established by the Manpower Development and Training Act of 1962 and have since been greatly increased by amendments made in 1963 to the same act and by the Vocational Education Act of that year. The Area Redevelopment Act of 1961 also provides for *ad hoc* training courses in occupations which will assist the economic growth of a depressed area. Such courses range from short periods of 120 hours of instruction (e.g., sewing machine operator) up to 2 years' full-time attendance or 1,920 hours (e.g., dental assistant). They are held in 4-year colleges, 2-year junior colleges and in area vocational schools. Some of the occupations are highly specialized, e.g., bench worker, plastic or fancy stitcher (boot and shoe). It is difficult to include these under apprenticeship in the traditional sense of that word.

In addition to apprenticeship and accelerated training for adults under the Manpower Act, many industrial firms have Training Within Industry (TWA) schemes which give *ad hoc* training for specific jobs. Re-training becomes necessary should the job change its character or the worker change his job.

The policy in many American industries is to break down any skilled process into small steps, each of which is almost unskilled and can be undertaken after a short training period. This practice, although viewed with disfavour in many European countries, is engaged in the reverse process of rendering their training schemes polyvalent. It may in fact be the method of the future, as it is more capable of adjustment to rapidly changing techniques, and creates a desire for change rather than a resistance to it.

THE VOCATIONAL HIGH SCHOOL

Such schools were once the last option for the less able scholars of junior high schools, or those who were unable to enter college for financial reasons and therefore required a quick means of earning a living.

In recent years the vocational high school has come to earn much greater respect. This recognition is due to a number of factors among which are a more enlightened policy, a partial remission of apprenticeship time for the time spent in school, a high wage now earned by skilled tradesmen, and the adoption of extension courses for technician training. Some of the schools can now exercise a selection among applications for the first year.

The type of curriculum provided for young boys and girls between 15 and 18 is that which gives general education and technical training (practice and associated theory) in approximately equal proportions. To achieve this, mathematics, science and technical drawing are all counted towards the general education time, together with physical training, military training (cadet corps) and health education. The school includes an average of 40 periods of 45 minutes each, making 30 hours of total attendance.

The trades covered by these schools include courses in commerce, industry and fields such as agriculture. Attendance by girls is mainly in the fields of home economics, nursing and commerce. Very few girls are enrolled in the industrial trades courses. Moreover, many such schools accept only men.

After completing the programme the successful student graduates with a vocational high school diploma and a trade certificate of competency in practice and/or theory. He may enter employment directly or may apprentice himself. The wages paid in the latter category are usually higher than the rate initially paid to graduates going directly to work. Some remission of the apprenticeship period may be given depending on local customs and trade union practice.

The vocational schools are at present providing more than double the number of potential skilled workers than the industrial apprenticeship system provides. The number of graduates remaining or even entering their particular trade is not known with any accuracy.

There is no nationally standardized or federal trade certificate issued by these schools as there is by their European counterparts although certain industries have undertaken to certify apprentices in their own field of work with the support of the State apprenticeship councils.

THE AREA VOCATIONAL SCHOOLS

The Vocational Education Act of 1946 (George Barden) and Title VIII (Education) of the National Defence Act of 1958

provide for the setting up and maintenance of area vocational technical schools, with 50 per cent federal aid. Their aim is to prepare pupils for direct employment at the age of 18. The area vocational schools have, however, tended to achieve junior technician standards (see Chapter III) rather than the basic skilled worker standards of the vocational schools operating on the Smith-Hughes Act. Less time is spent in the workshops and more in lecture or laboratory work. Such schools serve an area extending over several school districts and may have federally subsidized hostels attached (Section 14, Vocational Education Act 1963.)

YUGOSLAVIA

In 1965, skilled and highly skilled workers accounted for 36 per cent of the working population whilst graduates of the higher and secondary schools came to 15 per cent. The latest economic plan calls for the continued development of general and technical education to meet the country's economic needs. This will require more effective secondary schooling and technical training, with a corresponding expansion of instruction at the technician and university levels.

The skilled worker may, as in other countries, be trained wholly in school or partly in industry and partly in associated theoretical classes. In the former case the school has workshops which engage the student in some form of production work. In the latter system, theoretical instruction is given in classes, which, for purposes of efficiency, consist of groups from several enterprises at a school centre (see below), unless there are a sufficient number of apprentices in one enterprise to justify separate classes.

THE SCHOOLS FOR SKILLED WORKERS

These schools admit students after 8 years of elementary education, or at about the age of 15, and offer a course varying from 2 to 3 years according to the trade to be learned. Practical work occupies 50 per cent of the weekly curriculum (cf. Appendix II for a specimen curriculum). Such practical instruction is organized on the basis of specially prepared training programmes designed to give direct application to theoretical instruction. These institutions, called 'schools with practical instruction', began in the years immediately following the Liberation and have since increased subject only to financial limitations.

Those qualifying do so mainly in the following areas of industrial activity: (a) metal trades: fitting, turning, mechanics, etc.; (b) building trades: masonry, joinery, carpentry, decoration, etc.; (c) agricultural occupations: arable farming, horticulture, fruit-growing, etc.; (d) textile industries: weaving, spinning, finishing, etc.; (e) miscellaneous: timber, catering, chemicals, retail trades, etc.

The present system tends to adapt the types of technical personnel trained, the curriculum and the techniques of instruction more fully to the requirements of individual enterprises. The result has improved the quality of education and shortened the schooling period. These schools are also to be reorganized on a broader basis to provide school centres for other levels of technical education.

THE WORKS SCHOOLS

The works schools follow the same programme as the above vocational schools. In the large enterprises the whole curriculum, theoretical as well as practical, is provided in the works. However, practical training is increasingly given in the works and theoretical instruction in the local technical school centres which are often closely associated with or located on the actual premises of an industrial or agricultural enterprise.

There has been a tendency in the past three years to introduce into the curriculum more general education with a greater emphasis on mathematics and the natural sciences.

THE SCHOOL CENTRE

School centres of vocational training are intended to provide training and education for various specific occupational levels. Admission will in the future require 8 years of basic schooling, a requirement at present difficult to insist upon as some pupils have had only 4 years of elementary schooling. For such pupils there are evening classes of general education which assist them in attaining the necessary entrance standard.

In addition to the basic training of skilled workers described above, the school centres' range of activities will be expanded. General education for skilled workers already employed in the industry will be improved and the schools will offer advanced specialized courses for professional improvement. Basic technical instruction lasting three or four months will be offered to semi-skilled workers coming from rural areas.

APPRENTICE SCHOOLS

Training of skilled workers is also provided in apprentice schools which admit applicants with full elementary education. The pupils of these schools work and attend classes at the same time. The duration of studies varies from 2 to 3 years. Apprenticeship is regulated by law. The working hours of pupils in apprentice schools (practical training) may not exceed 24 hours a week. Pupils must attend school regularly and employers are requested to abide by this rule. These pupils are not permitted to do overtime, night work, or any inappropriate or hard production labour. Social security, minimum wages and vacations are guaranteed by law.

Although the theoretical courses in these apprentice schools are, in principle, similar to those in the schools for skilled workers, there is actually a considerable difference in the curriculum and the method of instruction. For a large number of pupils, systematic instruction in vocational subjects is not given with reference to their specific trade and, where it is, there are only short courses of a few months. Furthermore, practical instruction is not offered in these schools; consequently theoretical instruction is entirely separate from practical production work, and the school has only an auxiliary role in vocational training.

Continued improvement in the development of this form of education of skilled workers has recently been noted: mixed schools or classes for apprentices are being replaced by schools for apprentices for specific trades; central and periodic schools are being opened in which theoretical and practical instruction are given over longer periods; in larger enterprises practical instruction is carried out by skilled personnel who teach respective theory along with practical instruction.

ON-THE-JOB TRAINING AND EXAMINATIONS

As a result of the high demand for skilled workers and the mass migration of manpower from rural to urban areas, the majority of skilled workers have been trained in this way since the war. The importance of on-the-job training is also evident in the fact that it is combined with other forms of training and also it meets the needs in personnel when other possibilities of schooling fail. Furthermore, there are trades for which it is neither practical nor possible to open special schools.

However, on-the-job training, is less satisfactory than that

acquired in corresponding schools. In practice, it shows many inadequacies due to insufficient preliminary education, unsystematic on-the-job training, an insufficiently demanding curriculum and short-comings in the work of the examination commissions. It is necessary to devote serious attention to the solution of this problem, in order to provide a solid basis of general culture, socio-economic education and knowledge of mathematics and the natural sciences.

The latest amendments in the instructions on examinations, the opening of vocational training centres for workers and the broader participation of workers' and people's universities have been important contributions to the improvement of vocational training through practical work. The implementation of the Federal Assembly resolution concerning examinations in appropriate vocational schools is now under way.

The training of new workers, mainly adults, for specific trades or for actual jobs is increasingly being provided in factory centres for workers. In a planned and intensive training programme, within a limited period of three to five months, priority is given to tasks and methods of work based on accepted technological processes. In this way the enterprises in which these centres exist satisfy their immediate needs. The value of on-the-job training and, even more, of planned training, depends on the support of the respective economic organization and on the preliminary training and ability of the individual candidate.

These centres exist chiefly in large industrial enterprises but are also established for the needs of smaller enterprises and for specific branches. The large enterprises train and adapt their personnel to their internal needs and to the needs of enterprises with which they co-operate. Worker's universities organize certain types of training or supplementary theoretic education.

WORKERS SEEKING HIGHER QUALIFICATIONS

Qualifications for highly specialized jobs may be acquired by attending special schools (schools for master craftsmen or for highly skilled workers) or by passing an examination, usually after 3 years of work in the trade. Chief workmen are recruited from among these highly skilled workers for posts as production organizers in such trades as industry, mining, building and construction, transport, commerce and hotel management.

The schools for highly skilled workers have no uniform standard of admission, length and course of study and level of instruction. Frequently the programme of these schools is taught at the level

of the schools for skilled workers because the candidates vary widely in their preliminary education. Workers who have passed the examination for the higher qualification after 3 years in the trade are usually below the level of those trained in the schools for highly skilled workers.

The number of workers qualifying from these schools increases steadily, as shown by the following table.

School year	Pupils	Qualifying per year	School year	Pupils	Qualifying per year
1949/50	774	200	1954/55	3 267	622
1950/51	434	300	1955/56	5 124	1 120
1951/52	514	324	1956/57	7 367	1 876
1952/53	875	435	1957/58	9 580	2 870
1953/54	1 370	455	1958/59	10 634	3 056

Further study for promotion to the higher technician grades can be achieved by part time or correspondence course study, as described in Chapter III.

CHAPTER III

TECHNICAL EDUCATION AND THE TRAINING OF THE TECHNICIAN

The term 'technician' applies to persons working in occupations requiring a knowledge of technology and related sciences between that of a skilled worker and that of an engineer or technologist; occupations at the technician's level may call for inspection and maintenance, detailed development plans, supervision of production work, detail construction. Collaboration with the engineer is an essential part of the work of the technician.[1]

Though the term 'technical education' is at least a hundred years old, the use of the word 'technician' is relatively recent. Its precise occupational meaning is still not well defined but the fact that occupational levels exist between that of professional engineer (or technologist) and that of skilled worker is obvious. In fact the gap is so wide that two intermediate levels are called for, which will be referred to as 'technician' and 'higher technician'. The meaning of the word 'technician', originating in the industrial field, is now extended to denote a certain academic and social level intermediate between 'skilled worker' and 'engineer'.

Although not all industries need such a category, there are but few at present who have not taken some action to utilize a level of training below that of university or full professional qualification, if only because university graduates are scarce and expensive to produce. Whilst persons with this level of training are in great demand, especially in developing countries, the number being trained is never sufficient to meet the demand. The prestige value of university studies and the increasing financial assistance governments will provide for university students have caused the volume of technician training to remain

1. Recommendation concerning technical and vocational education, adopted by the General Conference of Unesco at its twelfth session, 1962, paragraph 2 (c). Text in English, Spanish, French and Russian.

quite inadequate for national needs. This lack is acutely apparent in the United States and has been so in Western Europe until recently. In the Soviet Union technical training for this level only just keeps up with industrial demands.

Some countries, in the enthusiasm of setting up their own often expensive universities producing only small numbers of highly qualified men, have tended to neglect the 'technician' and 'higher technician' levels. The intermediate levels of training are less costly, can be recruited from lower levels of secondary education, and fulfil many of industry's needs as well or better than the professional graduate. The situation, however, is rapidly changing and this level of education is at present the expanding area of technical education.

There remains the unresolved problem of whether the education of a technician should precede his practical training in employment (as in a French *lycée technique*), follow some period of apprenticeship (as in the *Ingenieurschule* of the Federal Republic of Germany), or adopt a 'sandwich' form by alternating periods of college with practical experience (as in the United Kingdom).

Although they differ in method, each system has its merits and each produces very capable technicians. It would seem that industry would profit from the three varieties even within one country, and that both the country and the students would profit from the triple possibility of full-, part-time and 'sandwich' courses. Each country must adopt its own system according to finance, potential co-operation from industry and the type of educational establishment available or contemplated.

One of the most striking developments has been the use of the technician route of education and training as an alternative to that provided by the university. Only a small percentage, 10 to 20 per cent, of the more gifted students reaching higher technician status and wishing to go further, have taken advantage of these schools. The relation of this type of programme to the other school-to-university courses will be further discussed in Chapter IV.

Possibly the greatest impediment to the development of technician courses has been adverse public opinion, which exists even in those countries which have the greatest need for them. For many years the single system of higher education found it difficult to accept an intermediate level between the secondary school and the university. Schools with intermediate goals were regarded as second-best and their graduates as university failures. The fact that some technician qualifications could be obtained without having completed secondary education also mistakenly belittled their worth even though their ultimate level was higher than

any secondary qualifications quoted. The idea that qualification as a technician might be used as a condition of university entrance with possible exemption from part of the latter studies has been so repellent to those brought up in the old traditions that there are still some European countries which have not yet given support or even approval to such a programme.

Likewise it has taken a long time in some countries to accustom leaders of industry to make more effective use of the technician grades and to recognize their capabilities. In the United States t has been found expedient in recent years to issue brochures and other publicity material in support of the greater use of technicians. Even so in 1961 the United States was training three times as many engineers as technicians. All these difficulties and deficiencies, however, are now being rapidly abolished by the more progressive countries as the following national accounts will show.

CZECHOSLOVAKIA

Technical training to levels above that of the skilled worker has long been in practice in Czechoslovakia, as is indicated by the year of establishment, 1707, of the institution that has now become the Czech Technical University in Prague. This chapter, however, is concerned with intermediate levels between qualification as a skilled worker and full professional or university graduation. The technician level is provided for in several ways:

1. The secondary vocational school provides a 3- or 4-year course for those leaving the 9-year school which includes both specialized technical training and general education to meet university-entrance requirements. This school also provides a 2-year course specially designed for those who have already completed their 12-year secondary education, and then desire a complementary technical training for industrial or commercial employment.
2. The vocational school does not give complete secondary education but offers a 2-year full-time course of training in certain appropriate occupations, e.g., secretarial, horticultural and poultry-keeping.
3. The secondary school for young workers provides part-time courses for those who have completed the 9-year school followed by apprenticeship training, have qualified as skilled workers and wish to improve their qualifications and status. The secondary school for young workers also admits pupils

who have not completed their 2- or 3-year vocational education, or those who, after 9-year schooling, failed to take up organized apprenticeship but have at least 3 years' practical experience. These three grades enter at different levels in the 3-year part-time course.

Categories 1 and 3 of the above schools, whilst themselves training to technician level, also permit those who have obtained the appropriate leaving certificate to apply for entrance to university courses.

SECONDARY VOCATIONAL SCHOOLS

This range of schools is classified according to a schedule which distinguishes the main types: industrial, agricultural, forestry, commercial, social services; nursing and health, adult education and the cultural services; music, applied arts and industrial design. Each type of school groups together a number of different industries. For example, an industrial (technical) school offers mechanical and electrical engineering, chemical technology, nuclear physics, mining, geology and prospecting, power generation, metallurgy, food production and processing, wood-pulp and paper industry, printing, building, surveying, transport and communications. Each area of study offers various specializations which prepare the pupil for the various branches of the industry concerned, e.g., precision mechanics and optics, technology and mechanical equipment of foundries, food-processing machines and equipment.

These specializations, however, do not mean that the curriculum prepares the student only for a single or limited occupation for, as will be seen from the specimen curriculum given in Appendix III, the greater part of the time is spent on basic subjects which adapt themselves to a wide range of occupations.

At the conclusion of the 4-year course the successful students may apply for entrance to a university, or seek employment in the middle levels of industry as technicians, planners, designers, maintenance foremen, etc.

Entrance to the secondary vocational schools is normally from the 9-year school but there is an increasing enrolment of students having completed their twelfth year of secondary school. In the latter case the curriculum is composed entirely of specialized theoretical and practical subjects and is completed by the passing of a second school-leaving examination.

Selection for the 4-year vocational schools is determined by

the recommendation from the teaching staff of the 9-year school, an entrance examination, 1 year's prior practical experience, preferably in training, and the recommendation by the industrial enterprise where employed. These schools are provided with hostels where necessary. All secondary-school pupils in both general and vocational schools are eligible for grants, the amount of which is based on family circumstances but is quoted (1963) at 70 to 325 crowns annually. Other benefits such as reduced fares are also awarded. A nation-wide service of vocational guidance making use of national social organizations, as well as employment offices, is available to give guidance both to parents and to young people leaving the 9-year schools.

SECONDARY SCHOOLS FOR WORKERS

These schools link their curricula on a part-time basis to those of the apprentice training centres and schools. They provide all the instruction necessary for the completion of secondary education, thus opening up many routes for the educational advancement of their more successful pupils.

Although the foundation of these schools dates only from the 1959/60 session, enrolment has already reached 15,000 and is rapidly increasing. The course lasts 3 years for 16 hours per week, half of which is time taken from the regular work day and half from the student's leisure time. Some of the courses may be taken by correspondence. Such courses are provided both in the apprentice training centres of industrial enterprises and in the secondary vocational day schools. In both cases the teachers' salaries and teaching aids are provided by the district national committees.

Those who succeed in the 3-year course may, if they qualify, apply for entrance to the university for higher study. If they choose to remain in industrial employment, they qualify in a higher category than the graduates of the secondary vocational school, since they have completed both their apprentice training and their secondary general education. They have an advantage in the selection of personnel to be trained as foremen. Specimen curricula for these schools are included in Appendix III.

THE GENERAL SECONDARY SCHOOL

Although the general secondary school does not concentrate on technician training, its new orientation has provided a basic

introduction to various forms of apprentice training through the concept and practice of polytechnical education. Pupils work six hours per week in industrial, commercial or agricultural enterprises that are associated with the school. In the theoretical curriculum two hours per week are devoted to technical means of production. Manual work during the summer holidays is also organized. Thus prepared, any subsequent vocational training, either as skilled worker or as technician, is considerably shortened.

THE WORKS INSTITUTE

Section 14, clauses 1 and 2, of the Education Act of 1960 provides for works institutes which 'shall provide further technical education with special reference to a given trade and the required general education for workers who have completed vocational or complete secondary vocational education and have had several years of practical experience. Courses of study at works institutes shall last at least two years'. A system is thus provided for up-grading to higher technician level.

FRANCE

The development of technician training in France has been so rapid over the past 10 years that even a brief study of the system becomes obsolete. The intensive acceleration of this form of education is intended to continue under the Economic Development Plan No. IV and to show a higher growth rate than any other aspect of the educational system. The following estimated statistics make this clear.

Educational establishment	Pupils (in thousands)		
	1961/62	1966/67	1970/71
Collèges d'enseignement général	630	824	866
Lycées classiques et modernes	822	1 075	1 154
Collèges d'enseignement technique	222	341	406
Lycées techniques	205	420	516
TOTAL	1 879	2 660	2 942

These figures do not include private establishments, or those pupils that may be left in *l'enseignement terminal*, the former *école primaire*.

The technician group (*lycées techniques* above) will thus form some 17 per cent of the relevant age group to which must be added the students coming from the *promotion du travail* courses. If the meaning of the term 'technician' is extended to include those students from the *lycées*, or *collèges d'enseignement général*, who do not proceed to a university but undertake some form of specialized training for subsequent employment, the total exceeds 50 per cent.

However, these figures are estimates and the present position shows a very serious deficiency. In the beginning, technician training was carried out in the former *écoles nationales professionnelles* which until 1920 were under the aegis of the Ministry of Commerce. After 1945 these schools were supplemented at a slightly lower level by the *collèges techniques*. Up to 1954 there were only 29 *écoles nationales professionnelles* in France, six of which were for girls. Under the Reform of 1959 both these types of technical institutions became *lycées techniques*. The intake age of pupils, once at 11 years, has been progressively raised during the past 10 years and when the reforms of 1959 and 1962 are completed will be raised to 15. The following are the different grades for which the students are trained.

1. The *agent technique*. Following the 11-15 cycle of lower secondary education the student may enter a 2-year course in a *lycée technique* to prepare for the qualification *brevet d'agent technique*. This qualification is the successor to the previous 'BE' series—*brevet d'enseignement industriel* (BEI), *brevet d'enseignement commercial* (BEC), etc.—which had established themselves as suitably qualifying their recipients for junior employment in industry and commerce. The *agent technique* qualification is not awarded until after a period of practical experience and training in industry.
2. The *technicien*. A 3-year course following the 11-15 cycle of secondary education provides training for the *brevet de technicien* qualification. This is the successor to the former *brevet* of the *écoles nationales professionnelles* and is intended to provide for the *cadres moyens* or section leaders, and those fulfilling responsible technical functions under only a general professional leadership. Here, too, a period of practical industrial experience is a necessary condition of the award of the qualification. This qualification also affords access to the five newly founded *écoles d'ingénieurs de fabrication* after competitive

entrance examination. The *baccalauréat* is not a necessary condition of acceptance. The *brevet de technicien* combined with two years of industrial experience is sufficient for admission to the science faculty of a university.

3. The *technicien supérieur*. The institution of courses in the *lycées techniques* for higher technician training is a recent development. The courses are not yet standardized and vary according to the requirements of each industry. The pupils are recruited from the technician courses previously described, from the courses in general education *lycées*, from those applying for entry to engineering colleges, and from part-time courses of the *promotion du travail* organization. The qualification awarded—the *brevet supérieur de technicien*—has been made the legal equivalent of the *baccalauréat* for certain subjects and is valid for entrance to a university or a *grande école*.

   The students in these sections enter industry as high-grade technicians supporting the professional engineer. Part-time studies are available in some areas for promotion to the executive level or to research activities. The decree of 14 January 1964 defines the status in industry of the holders of the *brevet supérieur de technicien* as well as the conditions of its award.

UPGRADING COURSES FOR THOSE IN EMPLOYMENT

The programme known as *cours de promotion du travail* provides, in the larger urban areas, a system of part-time study by which many of the qualifications for skilled worker and technician, and even the *diplôme d'ingénieur*, may be gained. There are three main administrative organizations for this work:

1. The Conservatoire National des Arts et Métiers, founded in Paris in 1794, now has branches in 20 or more towns and provides a variety of different courses at various levels. Some 17,000 students attend the Paris school and 32,000 study in the local branches. Apart from annual certificates showing completion of various courses there is the *diplôme d'études supérieures techniques* (DEST) (or *économiques*), of which 280 are awarded annually at the *technicien supérieur* level.

   The Conservatoire also has the very old but restricted privilege of awarding the *diplôme d'ingénieur* to those fulfilling their studies by part-time methods. Approximately a hundred such qualifications per year are awarded by the Conservatoire.

2. The Centre National de Télé-Enseignement provides a

nation-wide system of correspondence courses up to the level of *lycée technique*. About 33,000 students are studying by this means for some form of technical qualification and of these 15,000 are in the technician area of achievement.

3. The Cours de Perfectionnement sponsored by the Promotion Sociale programme provides for courses starting at the CAP level and continuing through the *brevet professionel*, the level of technician, up to the *diplôme d'ingénieur* that is awarded by one of the universities or *grandes écoles* now interested in this form of recruitment. About 31,000 qualifications are obtained annually by such means.

FEDERAL REPUBLIC OF GERMANY

The technician grade in the Federal Republic of Germany has long been recognized as necessary for industry and commerce. Consequently, the *Fachschulen* and *Höhere Fachschulen* have a long-standing reputation in preparing for the technician and higher technician grades. The establishments known as *Ingenieurschule* or *Technikum* also prepare for the latter grade. A clear distinction should be made between the qualification of *Ingenieur* and that of *Diplom Ingenieur* gained at a technical university or *Technische Hochschule*.

THE 'INGENIEURSCHULEN'

Entrance to the *Ingenieurschulen* or to similar commercial schools was formerly mainly from the *Realschule* (or *Mittelschule*), being the lower secondary form of education, or from a *Gymnasium*. Pupils leaving school at 16 with the qualification *Mittlere Reife*, enter training in industry with the status of *Praktikant*—a form of apprenticeship. After 2 years' experience—a period called *Praxis*—sometimes supplemented by 1 or 2 years of preparatory evening classes, the student may seek entrance to the *Ingenieurschule*, often done through a competitive examination. His application depends on local regulations and on the quality of the candidate's previous educational attainment.

The above method of entry is still the prevailing one. However, a second method, previously described in Chapter II as *Der Zweite Bildungsweg* (the second way), is now rapidly developing and in a few *Ingenieurschulen* more than half the pupils are those who have followed the *Zweite Bildungsweg*. This system requires

that a student, after leaving the *Volksschule* at 14 or 15, takes apprenticeship training, gains a skilled-worker qualification *(Facharbeiterbrief)*, acquires experience in associated crafts, and has attended a part-time day compulsory school *(Berufschule)* for 3 years and supplementary evening classes for $3\frac{1}{2}$ years. This system, leading to the *Fachschulreife*, is clearly equal if not superior to the preceding one.

The course in the *Ingenieurschule* is mainly scientific and technical, but it does include general or associated subjects—about 20 per cent of the curriculum—such as a foreign language, economics, aesthetics of design. The duration of the course, full-time, is usually six semesters, with some allowance made for entry into the second or higher years of the course for suitably qualified candidates. A specimen programme is given in Appendix III.

Pupils in the *Ingenieurschulen* who receive a 'good' or a 'very good' in the final examination for the qualification of *Ingenieur* are eligible, between the ages of 21 and 35, to receive a *Hochschulreife* provided they fulfil certain other educational conditions. This is the degree necessary for entry to a *Technische Hochschule* although in a limited range of faculties only. The 'second way' through *Fachschulreife* and *Hochschulreife* thus leads from apprenticeship to full professional qualification at the *Diplom Ingenieur* level. The number of persons following this road from beginning to end are a small proportion of the whole and plans are being discussed to find means to increase their quota.

The *Ingenieurschulen* have their counterpart on the commercial, artistic and social side. Advanced schools of commerce, agricultural institutes, industrial and applied art and industrial science schools are examples of the many forms of *Höhere Fachschulen*.

Not all apprentices are capable or desirous of pursuing such extended studies. On the lower technician level the *Fachschulen* provide day or evening instruction. They offer courses in mining, technology, sociology, commerce and agriculture, each of which has its separate faculty.

THE 'FACHSCHULEN'

The courses in the *Fachschulen* (as distinct from the pre-apprenticeship *Berufsfachschulen*) are intended for those who have already completed their basic skilled-worker training and their associated theoretical studies. Some courses require a period of further practical experience after apprenticeship as a condition of entry.

The length of the course varies between two to three semesters with day attendance and six to eight with evening attendance.

One of the main divisions appropriate to technician training is that of the *Technikerschulen*. Such schools (e.g., in Nordrhein-Westfalen) comprise one or more of the following departments: mechanical engineering, electrical engineering, textiles, textile chemistry, chemical industry, electroplating. The schools may be public or private.

The final examination is for the qualification of *Techniker*, a State-recognized qualification maintained at a level which is approximately uniform throughout the Federal Republic despite the division into separate provinces *(Länder)* for educational purposes. A specimen programme of study is given in Appendix III.

THE TEACHING STAFF

The education, training and experience of the teachers for all these schools present a special problem. For the schools mentioned other than the *Höhere Fachschulen*, the staff is pedagogically trained in addition to having general education *(Abitur)* and university education. The first teaching certificate *(erste Lehrerprüfung)* is given at the conclusion of the university studies, and the final one after 2 years of teaching practice.

The lecturing staff of the *Höhere Fachschulen (Ingenieurschulen)* is drawn chiefly from engineering and other industries without special pedagogic training. Likewise the workshop instructors are recruited from the ranks of experienced craftsmen.

Statistics for attendance in 1962/63 are as follows: 2,263 *Berufsschulen* with 1,614,035 pupils, 1,630 *Berufsfachschulen* with 132,298 pupils and 2,250 *Fachschulen* with 118,843 pupils. In the last category, *Fachschulen*, approximately 49 per cent were concerned with technical, industrial or artisanal training.

The *Ingenieurschulen*, including other forms of *Höhere Fachschulen*, comprise 112 establishments with a total of 52,000 pupils.

There are no charges for instruction in the *Berufsschulen*. A few of the *Berufsfachschulen*, the *Höhere Fachschulen* and private schools have tuition fees.

ITALY

The training of technicians is provided for in the *istituti tecnici*. There are several *istituti* of this type: *industriale*, for industrial

pursuits; *commerciale*, for commercial occupations; *agrario*, for agricultural employment; *pergeométri*, for estate management; *nautico*, for marine work.

The course is normally full-time and of 5 years' duration. Students apply at the age of 14 from the *scuola media* having earned the *licenza*, or leaving certificate of that school. In some towns and colleges, there are evening courses providing the same opportunities for study.

THE 'ISTITUTO TECNICO'

Several programmes are often available in any one variety of *istituto tecnico*, such as the study of mechanics, heat technology, electricity, aeronautics, electronics and nuclear energy.

The course-plan generally has 2 years of preliminary general study of a scientific or basic technical nature, followed by 3 years of specialized subjects, according to the line of study chosen. A specimen plan of study is given in Appendix III. The evening course likewise has 3 years of special study. At the conclusion of the course the students take the examination of *abilitazione tecnica* which, if passed, gives the qualification *perito* with an indication of the speciality studied in the course. Holders of this qualification may be offered employment at technician level in industry and public services. It also qualifies for technical teaching, but only in laboratory and practical subjects.

Formerly, the holders of the *istituti tecnico* diploma did not automatically qualify for entrance to a university or polytechnic institute (except in certain non-technical faculties such as statistics or languages), but the law of 1961 has now made entrance possible to the engineering, science and similar faculties. This was achieved by amending the course of studies in the *istituto tecnico* but students under the new plan will not be able to enter before 1966, although temporary measures have provided for a limited number to do so by special examination before that date.

Pupils who come from other lower forms of technical education (e.g., *scuola tecnica* or *istituto professionale*) are released from the first and/or second year of the course. Candidates who have studied by private means are authorized to sit for the *abilitazione* qualification subject to their previous full-time education record.

The fees for attendance and for the examinations are nominal. The proportion of the post-14 age group entering these technical schools is remarkably high as shown by the following table.

Type of institution	First year enrolment	Percentage of total enrolments	Percentage of age group		
			Male	Female	Total
Liceo classico	34 138	17.4	8.0	4.2	4.3
Liceo scientifico	14 631	7.4			1.8
Istituto magistrale	27 897	14.2	0.8	6.2	3.5
Istituto tecnico	76 096	38.6	14.6	4.4	9.5
Scuola tecnica / *Istituto professionale*	44 238	22.4	7.4	3.6	5.5

The 5-year course of the *istituto tecnico* relates to the middle-level technicians. In Chapter II there is a reference to the function of the *istituto professionale*, in particular those offering prolonged courses for junior technicians and specialized workers.

The concept of 'higher technician' at a level not far below that of the professional engineer is not yet fully developed or even well accepted in Italy. Two proposals are under consideration to eliminate this deficiency: (a) the higher technician level might be a first-level qualification in the existing university and polytechnic institute courses, occurring after 2 or 3 years in the 5-year course (this proposal has been published as part of the Ermini report in 1963, on the structure of Italian education); (b) the present *istituti tecnici* should provide such levels of qualification as an extension of their present work. Some are already doing this (e.g., Molinari and Feltrinelli in Milan) and the first students, *tecnici superiori*, graduated in 1964. These extension courses in industrial physics and industrial chemistry have been offered both on a full-time basis for 3 years or on a part-time for 4 years (19 hours per week for 9 months per year). The full-time students spend two months each year in an industrial employment appropriate to their speciality.

THE NETHERLANDS

There are two types of schools which train technicians in the Netherlands: the *uitgebreid technische school* (*UTS*) for the middle-level technicians, and the *hogere technische school* (*HTS*) training middle- to higher-level technicians.

The system is based on full-time attendance but part-time, usually evening attendance, is gradually developing, especially for the *HTS*. For the past 10 years a limited number of leavers from the *HTS* have continued their education at the *technische hogeschool*

(technical university), thus opening up the possibilities of 'a second way' in the Netherlands.

THE 'UITGEBREID TECHNISCHE SCHOOL (UTS)'

The purpose of the *UTS* is to provide for the essential medium-level trained personnel of industry: draughtsmen, draughtsmen-designers, assistant stress calculators, foremen, overseers, assistant managers. In addition, they train future managers of smaller businesses and trades (e.g., electrical installation contractors and building maintenance firms), and personnel for whom a basic knowledge of technology is necessary although it will not be their profession (e.g., a technical-administrative function as buyer, export salesman or representative).

The 3-year period is sometimes preceded by a 1-year preparatory class (the *schakelklas*) which accepts leavers from the *ULO*, the *LTS* or from the third year of the *gymnasium* or *HBS*. This preparatory year brings the standard of general education (languages, science and mathematics) up to an acceptable standard as the basis for subsequent technical studies.

The *UTS* accepts the leavers from the *LTS* at the age of 15 (see Chapter II) who have done well in the lower technical school and who desire further education and training. As a means of selection, an entrance examination is required. The course of instruction (see Appendix III) covers 3 years, of which one, usually the third, is spent in the industry itself.

The *UTS* schools teach not only engineering (industries), but also the fine arts, design, painting, sculpture, advertising, navigation, marine engineering, aeronautics, etc. This middle-level technical education is retained in the reform plan now pending, together with similar education for girls in domestic and agricultural-domestic occupations and for middle-level commercial employment.

THE 'HOGERE TECHNISCHE SCHOOL (HTS)'

This type of institution, aiming at the upper-middle to higher-technician level, trains personnel who will be the link between management and production, or who will become the managers of small industrial concerns. Since 1952, it has been possible to continue with higher studies in the *technische hogeschool* (technological university) after completion of the *HTS*. In practice only

5 per cent of the leavers go on to the *technische hogeschool* and they make up only about 8 per cent of the *hogeschool* student body.

Admission is normally at the age of 16 from the *ULO* school with diploma B, or after completing a 3-year course in the *HBS* or a 4-year course in the *gymnasium* (i.e., those qualifying for the fifth year in the *gymnasium*). In addition, a good pass in the final examination of the *UTS* is also sufficient for admission. Previous education to higher levels may exempt the student from the first year.

The normal course extends over 4 years, of which the third year is a supervised year spent in industry. The course (see Appendix III) covers a number of general subjects (languages, civics, physical education), basic scientific theory (mathematics, strength of materials, physics, chemistry, heat), special technical theory appropriate to the programme of study, and practical works (drawing and design, workshop, laboratory work).

As part of the total reform, admission requirements have been increased as from the school year 1965/66: entry is now possible after 5 years' education in the *HBS* (specialization in mathematics and sciences), or 6 years' education in the *gymnasium* (specialization in mathematics and sciences), and the length of the course may be varied between 2 and 4 years to suit the needs of different fields of occupation. The full 'higher technician' level, which might correspond to a mid-way point in university studies, such as the first degree of American studies, does not exist in the Netherlands. The gap between *HTS* qualification and full professional qualification after 5-7 years of study at the *hogeschool* is therefore very wide.

The *HTS* type of course has also been reproduced and offered on an evening basis. In this case, the entire course lasts 6 years, and the student is required to be employed in work related to the subject he is studying. He is encouraged to get practical workshop experience during the early years and experience in the drawing or design offices towards the final years.

During the week 16 lessons of 50 minutes each must be attended, totalling 13½ hours, between the hours of 6 pm. and 10.30 pm. This reproduces in 6 years the same amount of instruction as is given in 3 years of day attendance—the year's experience in industry for day-students is not, of course, required for those already in employment.

There are 23 such *HTS* in all. They have been slowly but steadily increasing in number with the result that 10,615 students were in full-time attendance in 1963, gaining 1,871 diplomas of which 30 per cent were in mechanical, 14 per cent in electrical

and 18 per cent in civil engineering. The figures for evening attendance are much lower, representing about one-seventh of the figures quoted for day attendance.

SWEDEN

The technician level of training in Sweden is at present the subject of much reform and discussion. The two institutions most concerned—the *tekniskt gymnasium* and the *fackskola*—have been under review by the Royal Commissions, whose reports were published in 1963. If these recommendations are put into effect as expected, a very satisfactory and modern system will be created.

THE 'TEKNISKT GYMNASIUM'

The *tekniskt gymnasium* still has only a fifth of the enrolment of the general *gymnasium* and can be entered only by those having a *realskola* or *grundskola* certificate. Two months of practical experience is also usually required before entry and an additional four months accomplished during the summer vacation before leaving. The course lasts 3 years (some are experimenting with 4 years) and terminates with the qualification *ingenjörsexamen*. This diploma gives a nominal right of entrance to the *tekniska högskola* (technical university). However, owing to the pressure of technical subjects and workshop training, it has become increasingly difficult to maintain the standard of the general educational subjects and, for that reason, candidates for the university are more numerous and more successful from the general gymnasium.

The proposals of the Reform Commissions (1963) will therefore give the technical *gymnasium* a 4-year course, whilst maintaining the scientific, economic, social and humanistic programmes at 3 years. Appendix III gives a specimen time-table for the existing 3-year course and the proposed time-table for the new 4-year course.

The new technical gymnasium will provide four main programmes: mechanics, electricity, construction and chemistry, Construction will divide after the first year into domestic and municipal installations, likewise electricity into the studies of heavy and light current. All the technical courses will have a common core of subjects (see Appendix III).

The necessary practical works experience has hitherto been obtained on industrial premises. The growth of these technical

gymnasiums together with the *fackskolor* will make this kind of instruction difficult, or impossible, to attain in sufficient quantity. It is intended, therefore, to provide school workshop practice in the first 2 years, but to arrange for two six-week periods of on-site training at the end of the third and fourth years.

It is hoped that these reforms will raise the yearly output to 7,000 *gymnasieingenjörer* with more than 5,000 entering employment directly as middle-level technicians. The remainder may proceed to higher studies in the university and eventually gain the full *civilingenjör* qualification.

THE 'FACKSKOLA'

The existing *fackskola* for technical pursuits is in effect a variant of the *tekniskt gymnasium*. In its full-time form, it provides a 2 year course, and requires 2 years of previous practical experience. In its part-time (evening) form the course usually takes 3 or 4 years, but only two months of previous practical experience are required. Entry requirements are at much the same level as the *tekniskt gymnasium*, except that foreign languages are not required. The course is more specialized, has fewer general subjects, and can therefore be kept shorter.

The qualification gained, *fackskoleingenjör*, is technically equal to the *gymnasieingenjör* but in fact does not meet the requirements for entry to a university. Recent reforms have, however, provided the possibility of gaining the full *ingenjorsexamen* by independent study following the *fackskola* qualification.

The new reform proposals for the *fackskola* give this type of institution a wider though slightly inferior place in the Swedish educational system. It is intended by the late 1970s that 80 per cent of Swedish youth will continue after the age of 16 in either a *gymnasium* or a *fackskola*.

The future *fackskolor*, some of which were already being experimented in 1963, will have three main divisions rather than the four proposed by the act of 1962: *social fackskola*, *ekonomisk fackskola* and *teknisk fackskola*. Only the last is further described here.

The technical *fackskola* will provide four programmes: mechanics, electricity, construction and chemistry. For all these, there will be a common core of technical subjects with special technologies varied to suit the option chosen. Both the construction and electricity programmes divide into specialities in the second year.

Admission will be open to all suitable candidates coming from

the *grundskola* with no entrance examination. Alternatively, skilled worker training may be acquired first and entry made later to the *fackskola*. For those who enter directly from the *grundskola*, a year of practical works experience will be required between the first and second years of the course. Successful completion of the whole course will be recorded by a certificate indicating the speciality, the subjects followed and the grades received. The more successful pupils of the *fackskola* will be enabled after the second year to transfer to the *gymnasium* in a corresponding programme of study and in the appropriate year of the corresponding courses. These *fackskolor* will produce the junior technicians of the Swedish system.

At present the junior technician levels are covered by the *tekniska skolor* (day or evening). Admission in the day course is at 16/17 after six months of practical experience, and in the evening courses at 15/16. The first level course is for the qualification of *tekniker*, lasting $1\frac{1}{2}$ years by day or 2 years by evening classes. Exemption from the work done in the first two semesters is sometimes given depending on the student's previous training. This level of qualification can be raised by subsequent attendance in more advanced technical courses.

In the major cities there is a more advanced institution *(teknisk institut)* which, admitting after the school-leaving examination, leads by way of the *tekniker* level to a further grade known as *institutsingenjör*. The duration of study is two terms (1 year) by day, or four terms by evening study, after reaching the *tekniker* level.

These institutions and their degrees will be diminished in scope and purpose as the *fackskola* system develops in order to avoid overlapping. A conversion of the *tekniska skolor* to the *fackskola* system can be anticipated.

The new *fackskola* organization is developing and is expected to continue as shown by the following percentages: 1963, 6 per cent; 1964, 25 per cent; 1965, 35 per cent; 1966, 50 per cent; 1967, 55 per cent; 1968, 65 per cent.

The two main levels of technician qualification in the new system will be as follows: at the conclusion of the new *fackskola* (not to be confused with the older *fackskoleingenjör* level previously described) with a diploma approximating the present *institutsingenjör*, at the conclusion of the new *tekniskt gymnasium* which, by reason of its 4-year course, should reach a technical level equivalent or superior to that of the present *gymnasieingenjör*. Beyond this is the *civilingenjör*—the full professional qualification of engineer—obtainable only by full-time university (institute of technology) studies.

UNION OF SOVIET SOCIALIST REPUBLICS

THE 'TECHNICUM'

The specialized secondary education offered in *technicums* and in similar colleges is an integral part of the Soviet educational system. It gives a programme of specialized secondary education, combined with the completion of full general secondary education.

In 1917 there were 450 such colleges having 54,000 students. At the present time there are 3,600 *technicums* and similar colleges with 3 million students. The education and training given are essentially for the middle-level technician personnel in industry, construction, agriculture, transport, etc. Specialized secondary education also covers pedagogy, the arts and para-medicine.

In the technical and the agricultural programmes the students obtain not only a technician qualification but also receive basic skilled worker training in a craft associated with the intended technician occupation (e.g., as a fitter, painter or tractor driver).

The duration of studies in a *technicum* varies between 3 and 5 years for those who enter after 8-year schooling and from $1\frac{1}{2}$ to 3 years for those who have completed their full (10- to 11-year) secondary education. Examples of both types are given in Appendix III.

Full-time attendance is the usual system but for those engaged in productive employment, there are correspondence and evening courses available through extension courses of regular universities or through institutes founded for that purpose.

Tuition in the *technicums* and in the majority of educational institutions is free and, in addition, facilities and grants are available to the students. In the day departments students successfully attending a *technicum* receive a yearly stipend and those whose homes are at a distance also receive a living allowance. Necessary journeys to the factory, farm, or other place of practical instruction are also paid. The external students who are employed while following a *technicum* course benefit from the following facilities:

1. They receive additional leave with pay for laboratory work and test examinations. With the evening courses, this amounts to 10 calendar days per year, for the first and second years of the course, and with correspondence courses to 30 days per year. In the third and subsequent years of the course, these figures increase to 20 and 40 respectively. Additional unpaid leave is granted during the State examinations for a period up

to 30 days and for the diploma project for a period up to two months.

2. They are paid for the time spent in laboratory and practical work or examinations, and reimbursed 50 per cent of the cost of the journey from the place of residence to the college and return.
3. In the final years of the evening or external forms of study, up to one month's leave without pay may be granted to permit the student to become acquainted with the leading industries in his specialization.

The entrance examination, open to all students, includes a test in the use of the mother tongue (Russian, Ukrainian, etc.), mathematics (written and oral) and other subjects appropriate to the specialization concerned. In the day departments, the age limit is 30, but in the external and evening sections there is no age limit. The committees which make the final selection of entrants are composed of academic staff and of officials of communal and social organizations.

The curriculum for each speciality is drawn up by the Ministry of Higher and Specialized Secondary Education. The day courses preparing technicians for future employment include three distinct periods.

In the first period the student receives both general and technical education, acquires a knowledge of the natural sciences concerned, and learns the practical skills of a working trade. Many of the *technicums* have their own workshops where the students make instruments and simple machine tools.

After the introductory period of 2 to 3 years and the acquisition of a working trade, the students embark upon a year of productive work in industry. They are regularly employed and receive normal wages based on the actual work completed. During the second period academic instruction is continued in the evening or by correspondence, particularly in those subjects related to the students' employment.

In the third period, the students return to the college and are again eligible for the academic stipend. During this period, they take an examination in their specialization, continue their programme, outline their project, and finally complete and defend their diploma project.

The curriculum of any *technicum* course may be regarded as composed under three main headings: general education, technical subjects and special technical studies. The content of the first is maintained on a level equal to the general secondary schools, and in this section literature, mathematics, history, sciences, languages

and physical education are included. A uniform level of achievement is thus assured in secondary education, general or specialized, throughout the Soviet Union.

Likewise, the uniformity of composition of the general technical section is maintained over a wide area of technical activity (e.g., industry, construction, transport) and includes such fundamental subjects as technical drawing, mechanics and electrotechnics.

In the special technical cycle the subjects are those which are related to the speciality chosen. For example, the curriculum of the speciality 'boilers' (see Appendix III) includes the special subjects, working of metals, foundry practice and the basis of welding techniques.

The whole course comprises extensive laboratory and design office work, including two or three projects. The type of project is determined by the speciality of the student and involves the detailed drafting of construction mechanisms. The content of the projects of the final course varies between colleges but efforts are made to implement them as a practical realization of the experience gained by the student during the second period.

This diploma project is the culmination of the programme and its purpose is to improve the existing technical processes, organization and methods of the industries concerned by outlining more modern instrumentation, or better design of the machine parts. Many of the diploma projects undertaken by graduates of *technicums* have been adopted by the industries concerned.

In some branches (e.g., agriculture, geology) the attendance curriculum is arranged on a seasonal basis, studying during the winter only and doing practical field-work in the summer. Similarly the students in the evening and correspondence courses pursue only the theoretical subjects of the course, the practical training being covered by their daily employment. It is a necessary condition that before termination of the *technicum* course and qualification, the student following the correspondence or the evening course must have had a year's working experience in employment appropriate to his speciality. Since there is no unemployment in the Soviet Union, this presents no difficulty.

UNITED KINGDOM

The schemes of technician training described below apply with only slight modifications to England, Wales, Scotland and Northern Ireland. There are three separate authorities all having some control over the status of technician; the Ministry of Education

(or the equivalent in Scotland and Northern Ireland) re-constituted in 1964 as the Department of Education and Science; the professional institutions, being chartered associations of professional engineers having statutory authority from the Privy Council for professional education of their members; and the City and Guilds of London Institute (CGLI), founded in 1878, which although originally concerned mainly with skilled worker qualifications, now has a series of technician qualifications, especially in mechanical and electrical engineering.

THE TECHNICAL COLLEGE

Leaving school at the minimum age of 15, the intending technician enters a part time (usually one day per week) course at the local technical college known as the General Course in Engineering (or Science, or Construction). Attendance is usually paid and is arranged to fit in accordance with his employment and working hours, i.e., with wages paid. The course lasts 2 years and is intended to be diagnostic and selective. At the end of a year, according to his performance, the student is either transferred to a City and Guilds technician course, permitted to continue into the second year of the course, or relegated to a skilled worker course.

Only the more academically minded who show unusual promise in mathematics are advised to follow the second option. All others are advised to follow the first option.

Following the first option (studying for a City and Guilds technician qualification), the young student attending only part-time will pass the first part of this qualification in 2 years, and pass the second part in 4 years (cf. the curriculum in Appendix III). These CGLI qualifications have only recently been established but are already rendering a valuable service. After the second part it is possible to take supplementary subjects and gain a 'full technological certificate'. This level is approximately equivalent to that of an associate degree in the United States.

THE NATIONAL CERTIFICATE SYSTEM

If the student chooses the second option, he will take an examination at the end of the second year upon terminating the general course. The results of this examination determine his future course. The subjects of the examination are graded with 'pass' or 'credit',

the latter being the higher. Two credits and one pass enable the student to enter a programme for the National Certificate. With three passes, he may enter the second year (T.2) of the CG technicians' courses described above. Less than three passes places the student in the first year (T.1) of the same course, or in a craft (skilled worker) course.

Those who gain entry to the National Certificate courses are joined by those who leave school at 16 with a General Certificate of Education (GCE) in at least four subjects, including mathematics and science. Together they commence a 4-year part-time (one day and one evening per week) course which leads to the Ordinary National Certificate (ONC) after 2 years, and to the Higher National Certificate (HNC) after 4 years. These courses are under the control of joint committees composed of representatives of the Department of Education and Science, the professional institutions concerned, and a representative of the technical colleges.

The Higher National Certificate at a technical level is slightly higher than a United States associate degree and approximates the qualification of *Ingenieur* of the Federal Republic of Germany though the breadth of study is smaller with little outside the minimum technical subjects necessary for the particular occupation.

Further courses called 'endorsement' subjects may be added in 1 or 2 subsequent years and may lead (see Chapter IV) to full professional status as a chartered engineer which ranks with a university degree.

The National Certificate system has been in operation in the United Kingdom for over 40 years and the programme attracts a great many students. In 1962, 20,134 candidates were awarded the ONC and 11,049 the HNC. Its main weakness is the length of time required to qualify. No one can acquire an HNC in less than 6 years, i.e., before the age of 21 starting at the minimum school-leaving age of 15, and most will be somewhat older through late starting or 1 or 2 years' failure.

Various methods have therefore been sought to shorten the time including: full-time courses with the award names changed to Ordinary, and Higher, National Diploma (instead of Certificate); sandwich courses, alternating college study and works experience in approximately equal proportions; and entry at a higher standard. In the last case the student may enter upon leaving school at 18. Those having at least one subject pass in the GCE at advanced level may enter a full-time or sandwich course for the Higher National Diploma and gain this qualification in 2 years' full-time or in 3 years' 'sandwich' attendance. This is

the highest of the technician type sub-professional qualifications and further progress is outlined in Chapter IV.

There is a continuous gradation of qualifications from skilled worker to the higher technician and professional levels, and a continual re-orientation of individual students according to their proven abilities. Diagnosis is made as much upon the marks gained during the whole of the course as upon examinations at the end of it. Advice given by the college staff to the student is not always obligatory. The student may reject it and make his own choice if he so wishes provided that he complies with the conditions necessary to pass to the next stage.

The description given has purposely avoided detail in order that the general pattern may be followed. There are in fact many other possibilities such as transfer from the final year of a craft (skilled worker) course (see Chapter II) to the second year of a technician course, or from the final of the CG technicians' course to a National Certificate course with exemption of 1 or 2 years.

With the better employers, day-release with wages paid is normally given in the engineering, building and many other industries. After the age of 18, attendance may have to be in the evenings, usually three periods per week of 2 or $2\frac{1}{2}$ hours.

FURTHER EDUCATION

The administrative section of the Department of Education and of the Local Education Authorities dealing with this form of education, whether full or part-time, is known as 'further education' (FE), and runs parallel, to some extent, with 'higher education', the term usually used to indicate the work of universities, including former colleges of advanced technology and teacher-training establishments.

The system for the training of technicians in the United Kingdom is thus a function of the Department of Further Education and not, as in France or recently in the United States, an extension of the secondary-school system. It solves the problem outlined in the preface to this chapter of whether practice or college study should come first, providing these concurrently or in short alternations (sandwich courses). It requires much co-operation between education and industry with employers willing to pay-wages for day-release attendance. There is no statute compelling them to do so, although the provisions of the Industrial Training Act 1964 may reimburse employers for these costs.

UNITED STATES OF AMERICA

It is only in recent years that the public and, in particular, those engaged in education in the United States have become acutely conscious of the need for training at the technician level. The technical institute had in fact been a feature of the United States educational system for over a century though its functions were negligible and its work was almost unknown. A report published in 1931 could find only nine institutions in the United States of the type now qualifying as technical institutes. The characteristic feature of such institutions is a 2-year full-time course, terminal and occupational in character, gaining a specified diploma and often accompanied by an associate degree recognized by the State.

THE ENGINEERS COUNCIL FOR PROFESSIONAL DEVELOPMENT

In 1944 the Engineers Council for Professional Development (ECPD) began a scheme of accreditation for technical institute curricula as it had done earlier for full 4-year degree courses in colleges and universities. From time to time in the annual reports of that council and elsewhere, lists of these accredited institutes are published.

In addition the junior colleges movement in the United States, and in particular its counterpart, the community college, had been for several years setting up 2-year programmes preparing students for transfer to a 4-year college at the third year level, or for employment after graduation, these courses being known as 'vocational terminal programmes'. Some of the latter programmes have been accredited by the ECPD and many others award the associate degree after recognition by the state. Some of the 4-year colleges and universities, in addition to their 4-year programmes for a full bachelor's degree have set up 2-year programmes as well. In 1958 the total number of institutions offering such courses of not less than 1 nor more than 3 years' duration was 767, of which 264 included technical studies. The enrolments were 206,374, of which 76,112 were in technical courses.

In 1961, 197 technical colleges had 36,186 full-time enrolments. Of these, only 32 colleges, 17,090 full-time and 7,041 part-time students were accredited by the ECPD.

The level of such technical training, if the ECPD-accredited course is considered alone, falls somewhat below that of *Ingenieur* of the Federal Republic of Germany and comes between the United Kingdom levels of Ordinary and Higher National Certificates.

Comparison is difficult in the latter case since the United States course contains a wider range of subjects with a slightly lower technical standard. A typical curriculum is given in Appendix III.

The standard of the remainder of the vocational terminal courses is subject to some state but no federal control and it is therefore difficult to make an exact appraisal of the value of an associate degree for the United States as a whole.

Entry to such courses at age 18 requires the applicant to have a high school diploma, but subjects like mathematics and science are often recommended. Such a level is usually below the level of the year preparing the French *baccalauréat* or the United Kingdom General Certificate of Education at 'ordinary level, 4 subjects'.

The graduates of these courses are now, after some initial hesitation, sought after by United States industry. A survey made between 1949 and 1961 by the Southern Technical Institute in the state of Georgia, covering 985 individuals, noted that the average commencing salary in 1961 was $400 per month rising to $751 after 12 years.

There are various substitutes for full-time attendance, e.g., part-time, day and/or evening, and co-operative study. This last option is the United States counterpart of the United Kingdom sandwich system, i.e., alternate periods of college and works training.

The total number of graduates is approximately 12,000 of whom only 6,035 were ECPD-accredited. Compared with the number of 'first way' engineers, approximately 36,000 per year, this gives an inverse ratio of one in three. The scarcity of technicians had in fact been evident for some time and under Title VIII of the National Defense Act 1958, a vigorous attempt is being made to remedy the situation.

NATIONAL DEFENSE (EDUCATION) ACT 1958

This act was the culmination of a movement to extend and improve education in the United States. Only Title VIII dealing with area vocational education concerns technicians. It authorizes federal subsidy, dollar for dollar, to state funds to provide for (a) full-time programmes for high school students in their last 2 or 3 years, tenth, eleventh, twelfth grade; (b) full-time follow-on programmes for high school graduates from 18 years upwards; and (c) extension courses for those in employment. The courses in the first group are virtually the same as those given in a secondary technical school but the curriculum offers a closer occupational basis than

heretofore, whilst those in the second group cover technician training at the first level. A specimen programme is given in Appendix III. It comes near in standard to the full technical institute level of work.

The two grades of technician in the United States are now commonly categorized as industrial technician and engineering technician. The latter is ECPD-accredited and the former may be the product of a technical school. The definitions, however, are still not precise.

In recent years, recognition of technicians has become a little better organized with the foundation in 1962 of the Institute for the Certification of Technicians. This body was sponsored by the National Society of Professional Engineers but is now an independent organization. Its board of trustees consists of four professional engineers and four senior engineering technicians, the latter being the highest form of membership in the new institute. This institute does no teaching, and does not accredit courses, this being done by the ECPD. The sole purpose of the institute is to accredit technicians as individuals and to issue a membership card in their name denoting their status.

There are three levels of membership : junior technician, technician and senior technician, with minimum requirements to be met through examinations with a view to raising the prestige status of the technician and clarifying the question of grade of qualification.

In addition to the 2-year full-time courses described above there are many part-time and evening courses. A few of these courses can lead to the associate degree level and/or ECPD-accreditation but rarely do so. There is no clearly defined national qualification in the United States which corresponds to the United Kingdom Ordinary National Certificate or to the *Tekniker* of the Federal Republic of Germany, although every large town has evening courses. These courses are extension departments of a university and prepare students for acceptance by that university. They also award their own degree. For example, using the premises of the Massachusetts Institute of Technology, the Lowell Institute organizes a 2-year evening course in both mechanical and electrical subjects. Attendance is for six hours per week for 30 weeks per year. The requirements for admission are similar to those for a United Kingdom Ordinary National Certificate.

Extension divisions of universities frequently organize part-time or short full-time courses of 20 to 30 hours' total attendance in specialized subjects. Pennsylvania State University offers this sort of course for operators of water, sewage and industrial waste systems at three succeeding levels—basic, intermediate and

advanced—awarding a Pennsylvania State Continuing Education Certificate upon termination of such studies.

There are also a number of private institutions offering full-time technician training of a type particularly appropriate to immediate industrial needs. The entrance fees to such institutions are high by European standards, so they are subjected to considerable pressure to limit the duration of studies to the minimum required to meet the standard. This has led some of these colleges to give continuous courses. This system is known as the 'four-quarter system'. Careful planning of class-room and laboratory work reduces waste time to a minimum and frequent small tests keep students aware of their rate of progress. A few such private institutions are accredited by the ECPD.

Compared with the carefully controlled technician qualifications of Europe, the United States situation appears disorganized at best but it is quantity rather than quality that is lacking. This failing is shared by every country in the survey.

The need for expansion of training within the wide range of attainments covered by the word technician has now been acknowledged by a rapid succession of relevant legislation. The Area Redevelopment Act of 1961 encourages training for a skill as a means of reducing unemployment.

The Manpower Development Act of 1963 extends the already wide training powers of the 1962 Act. By November 1963, 55,000 persons were enrolled in such training under 525 different occupational titles. The Higher Education Facilities Act of 1963 has made grants for construction of new buildings and facilities with 22 per cent of the grant being reserved for technical institutes and community colleges. The Vocational Education Act of 1963 expands the old Smith-Hughes and George Barden Acts and perpetuates the temporary provisions of Title VIII of the National Defense (Education) Act of 1958.

YUGOSLAVIA

SECONDARY TECHNICAL SCHOOL

In Yugoslavia the middle technician level is provided for by the secondary technical school *(tekniska skola)*. There are various types of technical schools—for general engineering, shipbuilding, textiles, building and civil engineering, mining, geology, agriculture, forestry, marine engineering, navigation, transport, postal service, commerce, hotel management, catering, domestic science,

applied arts, administration and library science; training auxiliary medical personnel, pharmaceutical assistants, dental technicians, etc.

Admission to the 4-year course is usually possible after the successful completion of the 8-year (age 7 to 15) basic school *(osnovna skola)*. In some specialities, a higher standard is required.

The curriculum is conceived under four main headings:

1. Vocational education: (a) practical workshop training in school and factory; (b) technical theory underlying production and organization.
2. General education: (a) including natural science and mathematics; (b) preparation for social life in productive labour.
3. Social and moral education.
4. Physical and health education.

A specimen curriculum is given in Appendix III.

A characteristic feature of technical schools in Yugoslavia is that they have been developing intensively during the entire post-war period. In the 1946/47 school year, there were 119 technical schools with 19,734 pupils, which is twice the number of both schools and pupils in the 1938/39 school year. In 1950/51, there were 243 schools with 65,651 pupils, whereas in 1964/65, the number of technical schools for youth increased to 529 and the pupils to 197,136. In the same year, there were 274 technical schools for adults with 19,510 students.

This dynamic growth of technical schools is the result of the rapid development of the economy and the public services, and the high demand for this type of personnel.

Technical schools which train personnel for the economy are located in economically developed areas. The widest network of technical schools exists in the large cities and industrial centres.

The organs of government and the economic organizations have opened these technical schools. In recent years, a growing number of individual economic enterprises or associations of economic enterprises have been opening technical schools.

The organizational forms of these schools developed along with the expansion of the network of technical schools so that there exist today several types of these schools. There are two kinds of technical schools for youth: technical schools with continuous instruction (i.e., the majority) and technical schools with instruction at two levels.

Schooling in both types of school lasts 4 years, the condition for admission being full elementary education. The difference between

these two schools is that in the school with a programme of studies at two levels, the first 2 years provide qualifications for the skilled worker level, and the second 2 years for the technician level. The schools with continuous instruction offer a shorter course of practical training. The technicians who finish these schools do not obtain qualifications as skilled workers.

HIGHER TECHNICAL SCHOOL

The growing need for a level of technician intermediate between that produced by the secondary technical schools and the full professional engineer has accelerated in the past 10 years the growth of the higher technical school *(visa tekniska skola)*. In 1950/51 5,340 students in 21 schools, rising in 1962/63 to 30,794 in 101 schools, shows the rapid growth that has been fostered by the present administration.

The type of productive activities covered by such schools of higher technical training are engineering, mechanics, electricity, building, non-ferrous metallurgy, agriculture, textiles, leather, commerce accounting, medicine, dentistry, social work, pedagogy (e.g., for teachers of home economics), foreign trade and statistics.

At present there are two broad categories of higher technical schools. The first type accepts students, with little or no practical productive experience, who often come from the academic secondary school. These students usually go into the fields of commerce and economics. The second type accepts students having 1 or 2 years of practical experience after secondary technical school or, alternatively, basic skilled worker training with some evening study, and leads to higher technical education. Such institutions are frequently located on the premises of, or in association with, an industrial enterprise.

In 1960/61, following a resolution of the Federal Assembly on the education of technical personnel, 44 new higher institutions were opened including 23 in technical fields of study and 15 for commercial training, 2 of these specializing in foreign trade. Appendix III gives a specimen curriculum of an engineering college of this nature.

Although technical schools are finishing schools, their educational structure opens the way to further education at higher schools and universities. Since there still is a great need for engineers, a large number of technicians continue studies at higher schools and universities.

THE UNIVERSITIES AND HIGHER TECHNICIAN TRAINING

The whole scheme of university study has recently been the subject of consideration and reform. Whilst the courses of study were long (5 years minimum) and their academic standards high, the university faculties and associated colleges were insufficient in number and sometimes unsuited to meet production requirements. Since 1959/60 reforms have been made which provide for 'multi-grade instruction' designed to produce various grades of technical qualifications.

The first grade, roughly corresponding to that of the colleges for higher education, trains higher technicians who, if not occupied full-time in the second stage of university study, may take up employment in responsible posts in industry and make an immediate contribution to the nation with the option of continuing their studies on an external or part-time basis. This first grade takes 2 to 3 years of full-time study.

The second grade aims at the normal university degree qualification and the third at the Master's or Doctor's degree. Both of these levels are, however, outside the scope of this report.

These reforms, combined with the important development of the 'external' system of higher education (correspondence courses plus short periods of full-time practical instruction), have provided Yugoslavia with a system of higher education more in keeping with modern requirements than that of many of the older tradition-bound countries.

CHAPTER IV

ROUTES INTO HIGHER TECHNOLOGICAL EDUCATION: 'THE SECOND WAY'

'The term "engineer" or "technologist" applies to persons working in occupations for which the need of education in appropriate sciences in universities or equivalent institutions of higher education is officially or traditionally recognized; this level of occupations would cover such activities as research, development, organization, planning and production.' [1]

It is not within the scope of this publication to discuss in detail the provisions in each country for higher technological education but to examine the routes now available from the lower levels of technical education to the status of full professional engineer. Recent developments in this area reflect the spirit of the recommendation adopted by the twelfth session of the Unesco General Conference, which reads: 'Technical and vocational education should be so organized that every person can continue his education until his potentialities have been developed to the full. Transfer from one field of technical and vocational education to others should be possible and access to all levels of both technical and vocational education and general education should be open to any capable person. Appropriate measures for making such access possible should be taken.' [2]

During the last 50 years, the barriers of class, race, sex or creed that circumscribed and inhibited admission to many universities have gradually disappeared. The last barrier, of which vestiges still remain in many countries, is that which places greater difficulties in the path of a student whose education has been or will be

1. Recommendation concerning technical and vocational education adopted by the General Conference of Unesco at its twelfth session, Paris, 1962, paragraph 2 (d). Text in English, Spanish, French and Russian.
2. Recommendation concerning technical and vocational education adopted by the General Conference of Unesco at its twelfth session, Paris, 1962, paragraph 14. Text in English, French, Russian and Spanish.

'technical' than on one who is concerned with a classical, modern, or even scientific education.

This attitude, still much in evidence, at first kept the great technological institutions out of the body of the university proper (e.g., the *Technische Hochschulen* of the Federal Republic of Germany, Scandinavia, Switzerland and the Netherlands and the *grandes écoles* of France). In other countries, e.g., the United Kingdom, it delayed the formation of university faculties of technology, or kept their numbers at an inadequate level, or caused the technological institutes to favour students coming from the academic secondary school of the classical type. Hence it was this attitude which brought about the foundation of a new type of institution, the technical college, and more recently the college of advanced technology. These new institutes often have a more comprehensive field of recruitment and provide for studies on a part-time or sandwich basis of attendance.

The barriers against the growth of technical education and the further education of technical school graduates have broken down. Universities are forced to come to terms with the swelling tide of numbers arriving by the educational route or routes now known in many countries as the 'second way'. It is with the meaning, the possibilities and the growing development of the 'second way' that this chapter is primarily concerned. In order to understand it in its proper perspective, however, a brief review of the 'first way' is necessary.

The 'first way', as previously mentioned, sees the student through the general secondary school which prepares him for higher studies in a traditional university. By such means some 7 per cent of the age group of a nation secured a university degree, of whom but a small proportion were interested in technological pursuits since the method of recruitment had generally favoured those with a more strictly academic mind. Even those secondary schools which provided technical courses rarely accepted more than 20 per cent of the relevant age group and usually less. The future university population was thus generally pre-selected among those who had shown superior academic ability at age 11/12.[1]

Such numbers, although exceeded in some countries, notably in the United States, are in modern times quite inadequate to meet national needs, and in any case only purport to cover the full professional levels. It was a foregone conclusion that a new

1. For amplification of this point and detailed statistics, see Frank Bowles, *Access to Higher Education*, Vol. 1 of the series entitled *The International Study of University Admission*, Paris, Unesco, 1963.

level of qualification and status—that of the technician—was a necessity, if only to support numerically the thin ranks of the professional engineers. It was necessary also, and probably much better, that this type of qualification should be built upon a form of secondary education and qualification that did not reach the full university-entrance standard as competitively demanded, more especially where this level, as in Western Europe, had become unnecessarily high by reason of competition for entry and often made compulsory such academic subjects as Latin, Greek and formal philosophy, which had no value in view of the planned programme of study.

Since 1880, a new trend of increasing importance has developed. This is represented in the Federal Republic of Germany by the present *Realschule*-to-*Ingenieurschule* route with 2 years' interpolated practical experience, in France, by the former *écoles nationales professionnelles* (now *lycées techniques d'état*) which train people for the middle ranks of industry, in Sweden by the *tekniskt gymnasium* or *teknisk fackskola*, and in Belgium by the *universités du travail* (Institut Paul-Pasteur).

In the United Kingdom the second way took on a somewhat different shape through part-time study for the Associate Membership qualifications of the various professional institutions. Many of these institutions had acquired a Royal Charter giving them semi-statutory authority to train and educate their members. In 1920 this movement brought the Ministry of Education into a partnership with one or more of the relevant professional institutions, by the setting up of qualifications known as 'National Certificates', and by organizing part-time courses in technical colleges. These courses and qualifications are exempt from the greater part of the examination requirements for Associate Membership which authorizes the graduate to practise as a full professional engineer. A 'second way' was thus created which normally terminated at the technician status and occasionally at a higher technician level. A few, approximately 5 per cent, continue all the way from apprenticeship status to full professional qualification.

In the United States and in the Soviet Union the technical institutes and *technicums* also provided for the middle levels but did not until very recently give access to further studies in a university or equivalent institute.

At the same time, the general principles of democracy favoured the proposal stated in the Unesco General Conference Recommendation quoted above, that no one should be debarred from final professional qualification because of age, lack of means, or being engaged in earning a living. In this manner the part-time class,

the correspondence course and the workers' educational movement developed massive numerical strength. One of the earliest institutions of this character and philosophy was the French Conservatoire National des Arts et Métiers, founded in Paris in 1794 and now having branches throughout France. This movement has become known in recent years as the *cours de promotion du travail* or *cours de promotion sociale* and is already having some success in terms of the final qualification *diplôme d'ingenieur* as well as at many technician levels.

In the United States, the development of the second way was not so apparent because of the large number of students who finished high school (at present 62 per cent as against 15-20 per cent in Europe) and because college entrance was much easier. Lower entrance standards and more possibilities for working one's way through college by part-time employment have contributed to the high number of college students. Furthermore the universities and other 4-year colleges have never rejected technological or even purely vocational studies.

The European second way starts at a point somewhat below the secondary 'maturity' certificate, which has no equivalent in the United States. Recent developments, taken up later in this chapter, do, however, intend to provide for this level, i.e., the drop-out from high school.

With such numbers reaching technician and higher technician levels, it was hardly surprising that a few students acquired the ambition and developed the necessary talents to proceed to full professional qualification. In the United Kingdom becoming an engineer presented no difficulty since by the National Certificate routes described in Chapter III full professional qualification could be obtained by attending such part-time classes, whether or not the full secondary certficate (General Certificate of Education) had been obtained at such a level securing university entrance. This does not mean that such students are allowed to bypass difficulties that the normal secondary school-to-university students have to face at an early age. On the contrary, the student following the second way usually has a greater volume of study. The distinguishing characteristic is that he does so in a different sequence and in a manner more closely allied to practical training, whether in the school or in the works. Some students who would have been unable to follow the traditional school-to-university route are successful even in theoretical subjects like mathematics. In the United Kingdom this new educational method was eminently successful. At one time nearly one-half of all professional engineers in mechanical engineering had been educated and trained along

this second route. But this success was a by-product of the existence of a level of professional qualification called Associate Membership, outside the sphere of the universities.

Elsewhere, the universities and institutes of technology themselves were as firm as ever in demanding full secondary 'maturity', usually at a high level, for matriculation. The *student examen* of Sweden is an example of the high requirements, comparable in academic achievement to the 2-year course (associate degree) of an American junior college.

The students of early technical schools dealing with craft (skilled worker) and technician levels were thus completely cut off from the possibility of entering the *Hochschule* since they lacked the necessary secondary 'maturity' qualification. For example, only in the last 3 years has the *Istituto tecnico* in Italy been permitted to send students to the engineering faculties of the universities. The universities had in this way cut themselves off from all but a small fraction (10 per cent) of the active population. For technology in particular, this was undesirable. The number of those trained in the universities was always far too small for future needs, and the ranks of those training for technician qualifications included many who could have risen to full engineer level with distinction to themselves and benefit to their country.

A developing country newly emerging into the world of industry and requiring industrial education to university level need not and perhaps should not build up its university system on such a small quota of its population. By using this second route and by combining it with older traditional ways, the university can become a true university of the people.

The metamorphosis is still in its early stages. Administrators and educators are often unaware of the increasing magnitude of this change and its importance in the new social structure. The new routes are particularly appropriate and valuable in technological studies but clearly have applications in other fields such as agriculture. Year by year and country by country the last obstacles in the second way are being removed, offering a clear route to the top for those to whom the practice-first-and-theory-later sequence of the second way is better suited than the more traditional opposite. A study of the present development in different countries will show how this reform is being carried out.

CZECHOSLOVAKIA

'Any inadequately educated young person means a serious loss to the community.' Such is the article of faith which, implemented

through the secondary schools for young workers giving part-time courses leading to the maturity examination of full secondary education or through correspondence courses, opens up possibilities of higher education for all. In addition, a third route is available through specialized secondary vocational education and thence by selection into higher education.

Furthermore, the greater part of higher education, whether in a university or in an institute of technology, is also available by part-time study for which a reduction in working hours is granted by the employing firm.

The academic secondary school is thus only one, although still the most direct, source of supply for entrants to higher education.

FRANCE

In 1946 the *baccalauréat technique* was introduced as an optional alternative to the academic *baccalauréat* then existing. The former permits the student to attend classes which prepare him for the entrance examination to the *grandes écoles* offering courses in technological subjects for the *diplôme d'ingénieur*. The one-time *écoles nationales professionnelles*, now called *lycées techniques*, prepare for the *baccalauréat technique*, necessary for entry to full engineer training. More recently, the *brevet de technicien* and *brevet de technicien supérieur* have been given official equivalence to the *baccalauréat technique* and thus qualify the student under certain conditions to participate in classes which prepare him for the entrance examination to a *grande école* or similar institute. The *cours de promotion du travail*, offered on a part-time basis in conjunction with the Conservatoire des Arts et Métiers centres, can in principle lead to the *diplômes d'ingénieur*, but this programme is extremely arduous. Some universities, notably Lille and Grenoble, are doing pioneer work in recruiting students from these programmes, independent of the *baccalauréat technique* and providing for full-time attendance with subsidies from industry and other sources.

FEDERAL REPUBLIC OF GERMANY

Whilst the Federal Republic of Germany and Switzerland were among the first to recognize the technician level achieved by attendance at a *Technikum* or *Ingenieurschule*, there was at first little if any possibility of going on to the *Technische Hochschule*. Now, a particularly successful student of an *Ingenieurschule* (or the

equivalent) can gain a *Hochschulreife* or *Fakultätsreife* and go on to a *Technische Hochschule* whether or not he originally gained the *Abitur* at his secondary school.

At a lower stage, a pupil leaving a *Volksschule* at 14 or 15 can, by going through the *Berufsschule*, *Berufsaufbauschule* and an apprenticeship, gain a *Fachschulreife* which meets the standards of the *Ingenieurschule* and continue thence to the *Hochschule*. This is *Der Zweite Bildungsweg* (the second way) of the post-war years. A variation is the creation of special full-time colleges, *Institut zur Erlangung der Hochschulereife*, where, after 2 or more years of full-time attendance or its equivalent in part-time attendance, adults may gain their *Abitur* and thus enter a university.

ITALY

Higher technological education at university level is available in the engineering faculties of several universities and in the polytechnic institutes of Milan, Turin and Venice. The courses last 5 years. Admission was formerly restricted to those with the qualification *maturitá* obtained after full secondary education in classical or modern studies in a *ginnasio* or *liceo*. Since 21 July 1961 the second way has been opened up by enabling those coming from the *istituti tecnici* with the diploma *abilitazione tecnica* to enter relevant technical faculties of a university. The Educational Reform of 1963 confirmed this and slightly extended the choice of faculties possible.

The *istituto tecnico* is, however, a full-time secondary school teaching students aged 14-19 and its diploma *(abilitazione tecnica)* is not normally obtainable by any other means. No national system of part-time classes has yet been established enabling a really able candidate from the lower levels of the *scuola tecnica* or *istituto professionale* to secure full professional qualification whilst earning a living, as is the case in several other countries, although correspondence courses are now developing at least for the technician level.

Whilst the *maturitá* of the classical *liceo* admits students to all faculties of the university, and the scientific *maturitá* to all faculties except letters, philosophy and law, the *abilitazione tecnica* diploma, despite the same 5-year course, admits (since 1961) only to engineering, mathematics and science faculties and to some in statistics and languages.

Progress is, nonetheless, rapidly being made in linking *istituto tecnico* with the university, and more particularly with the

polytechnic institutes of university status. Part-time studies at university level are also increasing in proportion to total enrolments but at present the qualification of *laurea* cannot be obtained in this way.

THE NETHERLANDS

Formerly the Technological University at Delft was the only centre for technological studies at university level and it recruited solely from the top secondary schools — the *gymnasium*, *lyceum* and *hogere burgerschool (HBS)*. There are now three such institutions, the second having been opened in 1957 at Eindhoven and the third in the Twente region in 1964.

Since 1952 recruitment has also been possible from the *hogere technische scholen (HTS)* whose courses otherwise terminate at the higher technician level. Since these *HTS* recruit in part from the *UTS* (middle technical school), from the *ULO* (lower secondary school) or indirectly from the *LTS* (vocational school), a complete ladder upwards from elementary-school level is thus available. Most studies, however, are on a full-time basis and only a few are available through part-time courses. The possibility of an able apprentice reaching the full professional engineer level by part-time study is very remote in the Netherlands, but at least the way is open and no doubt in time will offer increased opportunities.

SWEDEN

The main centres of higher technological education at university level are the Royal Institute of Technology at Stockholm and the Chalmers Institute of Technology at Göthenburg. In the last few years a similar institution has been founded at Lund and the applied physics faculty at Uppsala has entered the field of technological training. Entry to these universities is by means of the *studentexamen* of the *gymnasium*, or the *ingenjörsexamen* of the *tekniskt gymnasium*.

Part-time, mostly evening, courses for workers preparing for the *teknisk fackskola* are available in some of the larger towns. The *teknisk fackskola* is a variant of the *tekniskst gymnasium* organized on a basis of 2 years of full-time study, or 2 years part-time, with 1 year of full-time study, or in Stockholm 4 years of part-time study. By such means a working student can acquire nearly the same examination preparation as is needed to pass the *ingenjörsexamen* and after following this form of study, the diploma holder will be known as a *fackskoleingenjör*. Since 1959 the *ingenjörsexamen* can also be prepared for by correspondence courses.

Here, however, the second way course comes to an abrupt end, for, in practice, most university candidates come from the general *gymnasium* and the rest from the full-time *tekniskt gymnasium*. The qualification obtained in the *fackskola* does not at present give university admission, and, even if it did, the 5-year full-time university course would make it practically impossible for all but the most exceptional students to combine such studies with full employment.

Academic standards in Sweden are high, a fact which, whilst creditable in itself, has made it difficult to pioneer the second way. At present, therefore, the second way terminates, for practical purposes, at the level of *fackskoleingenjör* unless of course the student has the financial means to withdraw from employment and pursue full-time studies again.

The Education Reform Act of 1962 had in mind extensive post-school opportunities for further education through the setting-up of full and part-time study programmes which, when made effective, may extend the second way beyond its present academic limitations.

UNION OF SOVIET SOCIALIST REPUBLICS

The law of 1958 which aims at strengthening the link between the school and the economic life of the country and developing the public education system of the Soviet Union rules that any form of education from the age of 15 upwards is to be in close association with vocational training and/or productive employment. In that sense the second way in Russia has become the first way. Numerically the various part-time or external forms of study now form a very significant proportion of the whole: more than 50 per cent of the enrolments are of this type.

Admission to an institution of higher education is by competitive entrance examination, and preference is given to those who have already had 2 years of working employment and to ex-*technicum* students, with 3 years. Nonetheless, by direction of the State council for specialized secondary education *(technicums)*, the staff meetings of the *technicums* have the right to nominate up to 5 per cent of their best students for direct transfer from the *technicum* to a university or polytechnic institute.

In the evening and external forms of higher education, all citizens of the Soviet Union who have completed their secondary education may be enrolled, while continuing their productive employment. Of these, a fair proportion will be ex-*technicum* stu-

dents. Since the completion of secondary education may also be obtained by part-time attendance or by external study after leaving the 8-year school (37.5 per cent of all complete secondary certificates were obtained in this way in 1961), the second way is continuous from school-leaving at the age of 15 up to university-level qualification. There are facilities and grants for such part-time students in higher education as described in Chapter III for specialized secondary education.

Future plans include measures which are intended to promote part-time studies. These proposals include the shortening of working hours, better housing, free transport and communal services.

There are already 30 colleges specializing in evening and correspondence study, and more than 900 operating as extensions of day-attendance institutions. The total of such part-time enrolments is now over 1.5 million. An organized scheme of attendance for short periods to cover laboratory work and the final diploma project guarantees protection of wages for these purposes.

UNITED KINGDOM

In the United Kingdom higher technological education has long been shared between the universities and the technical colleges. The former, unlike their continental counterparts, accepted technology as a valid academic discipline and, from the late nineteenth century, technological faculties were set up in several universities in the United Kingdom. One of these, London, permitted external study for its degrees. Such external study could be wholly private, by correspondence, or by attendance at full- or part-time courses in a senior technical college. Later, in the 1930s some form of actual attendance at a recognized college became compulsory particularly for technological studies. In 1955 some of the larger colleges carrying out university level work were approved by the Minister of Education and later became designated as colleges of advanced technology to organize courses for a new Diploma in Technology under the supervision of the National Council for Technological Awards. These courses were to take the place of the university degree courses that had grown up in technical colleges under the London external system.

The 'Diploma in Technology' course differed in two important aspects from the course for a London University degree. It was usually set up on the 'sandwich' basis. A 4-year course was divided up into alternating periods of study and related employment and

the programme required that the applicant possess either the General Certificate of Education with two 'A' level and three 'O' level passes or he must have the Ordinary National Certificate (high pass) from the part-time technological college courses, in association with apprenticeship or employment. This enables an apprentice following a United Kingdom apprenticeship of 5 years to reach the qualification 'Diploma in Technology', equal in standard to an honours degree from a university, effectively within the period of his training with an industrial firm.

The college of advanced technology thus forms an appropriate summit to the second way in the United Kindgom, providing either for the ex-grammar-school boy going into industrial apprenticeship or for the part-time technical college student-cum-apprentice an opportunity of qualifying at full professional level. The Diploma in Technology, like a university degree, is accepted by professional institutions for Associate Membership requirements, so the student, at very little cost to himself, is usually sponsored, and in most cases paid, by an industrial undertaking. Following the recommendations of the Robbins Committee of 1963, the Diploma in Technology will now become a university degree in name as well as in level, and the college itself will be styled a university, but the route, the programme and the attendance required will all remain at the service of the second way student.

Further possibilities of a similar kind are to be opened up under the auspices of the Council for National Academic Awards in other technical colleges throughout the United Kingdom and many such courses will be on the 'sandwich' basis. When the student is sponsored and has wages paid by a firm for the whole period—college and works—he is known as a 'works-based' student. Under 'college-based' conditions the student usually receives some form of educational grant or scholarship during college attendance and may be paid a small wage during his industrial employment. The scheme is not restricted to a single type but deals with both as the following statistics (March 1964) show:

	1st year	2nd year	3rd year	4th year	5th year	Total
College-based	1 495	977	533	337	—	3 342
Works-based	1 716	1 390	1 251	980	39	5 376
TOTAL						8 718

These 8,718 students included 276 women, 27 of whom were in engineering and 249 in other technological studies. Of all entrants 20.2 per cent have come up from part-time study with an Ordinary National Certificate qualification.

The universities in Britain were not in 1963[1] under the control of the Ministry of Education, unlike other forms of post-school education. The volume of higher technological professional qualifications obtained through Diploma-in-Technology courses in colleges of advanced technology; London external degrees, by private or part-time study; Associate Membership qualifications by examination of professional institutions; higher national certificates and diplomas exempting from all or part of the examination of professional institutions is now as great, or greater, than the total output of internal university degrees.

The distinguishing characteristic of the British system of higher technological qualification is the number of different routes leading to full professional qualification. The university route full-time, whilst having lost none of its high traditions and prestige, is now only one of many routes.

UNITED STATES OF AMERICA

Higher technological education is provided by some universities, by institutes of technology and polytechnics and for introductory courses by junior and community colleges.

Admission requires the possession of a high school diploma, sometimes in designated subjects and with certain minimum specified credits. By European standards, this requirement is not a rigorous one. When subjects and standards are not specified, and when, as in some states, the state university is obliged to take all secondary graduates who apply from that state, the resulting standard of admission is very modest, certainly lower than in any European country. Far from being derogatory, this observation may rather be a valid criticism of Western European academic exclusiveness, for the United States 4-year college intake is around 36 per cent of the annual age group, a figure unequalled by any other country. Of these only about 55 per cent do, in fact, last out the 4-year course and earn a bachelor's degree. It is the course itself and particularly the first year of it which functions as the

1. A reform enacted in 1964 brings the university grants system within the control the Secretary of State for Education and Science.

selective mechanism rather than the entrance qualifications or the competitive examinations favoured by the academic traditions in the older countries.

Of those who are attending 2-year and 4-year colleges, a relatively high percentage, probably more than half, are working their way through college by earning through part-time employment not necessarily connected with their studies. Some co-operative courses have been established between industry and university, attendance being on an alternate college/works basis, as in the United Kingdom sandwich system. The student is paid wages only for the time he spends in actual employment.

The foregoing explains why the second way in the United States takes on a totally different character from that in Europe; nearly all those who seek to attain higher technological qualification are already in full-time attendance at such colleges.

Since over 62 per cent of the population graduates from high school, any part-time or alternative route to a higher technological qualification not unreasonably starts from that level. Few who had failed to graduate from high school would be likely to reach the university degree level even by another route. Recent acts (cf. Chapter I) have, however, now set up training courses to technician level for unemployed or under-educated youth. It is conceivable that these, in time, may develop into a nationally co-ordinated second way.

The junior college provides a locally introductory preparation for a more distant city or state university. It offers the first 2 years of a degree credit course from which the student may transfer with full credit to a 4-year college.

The technical institutes, of which there are few, offer 2-year terminal courses for technician type awards and occasionally associate degrees and may also give limited possibilities of transfer to 4-year courses with partial credit carried over.

The community college provides a 2-year occupational-terminal course for intermediate-level qualifications (associate degree) and/or a 2-year degree credit course transferable to a 4-year college.

Some of these colleges have evening attendance as an alternative means of qualification and some permit home study. Each state is free to model its own state university on its own ideals and many universities and colleges are independent institutions only under a very general form of state approval or recognition. Hence, practice varies greatly from one college to another.

Technological awards, both at the bachelor's degree level and at the associate degree level, are accredited by the Engineers

Council for Professional Development if they are of approved standard. This guarantees some degree of uniformity and in no way precludes part-time attendance or even correspondence course study provided satisfactory standards are maintained. It is not unknown for an educational foundation (e.g., Pennsylvania University) to include both 4-year university courses and 2-year technical institute programmes under one over-all administration with possibilities of transfer.

YUGOSLAVIA

Technological faculties are provided in several universities, notably Belgrade, Zagreb, Ljubljana, Sarajevo, Skopje and Novi Sad, many of which have extramural departments elsewhere. In addition there are a number of specialized colleges in fields such as physical education, administration, art and engineering. The last group was not intended to reach university degree level so that a student completing his course in one of these specialized colleges and wishing to enter the university had to start anew.

The Reform of 1960 has strengthened the link between these two components of higher education. The student in the first two years, common to both lines of study, is given sufficient practical training to render him useful at the technician level should he leave at that stage to continue for a university degree by part-time study.

The routes into higher education are now open after graduation from the academic or technical secondary school or from the ranks of skilled workers via the evening schools. These measures have had their effect and enrolments in higher education have increased from 61,585 in 1956/57 to 117,216 in 1961/62. The latter figure includes 31,723 part-time students and refers both to universities and associated specialized colleges.

The assimilation of technician training into the main stream of university studies and recruitment to higher education through various secondary-school qualifications greatly improved the educational pattern and provides for an extensive system of part-time study.

The use of correspondence courses for university studies is as yet in an early stage of development, but the principle of the second way, allied especially to productive employment and concurrent with part-time studies, is firmly established and strongly supported.

CONCLUSION

From observations of the second way in the preceding countries, certain conclusions may be drawn. A modern industrial country has need of more persons highly qualified in technology than it would be practicable, or even desirable, to produce by the full-time academic school-plus-university route. Young men and women in technical pursuits, with an interest in their work, will normally be eager to improve their personal qualifications and up-grade their usefulness in the industry. Every possible encouragement should be given to them to do this, not as an act of philanthropy but because such promotion is vital to the economic health of the nation and consonant with the principles of democracy.

The artificial distinction between university qualification at the higher technological level and other forms of qualification at similar levels of study is losing its practical and social significance.

The leaving certificate of full secondary education is no longer the only way to higher qualifications since many have shown competence at the highest levels after coming up the hard way with little more than primary education.

Bearing in mind the rapidly changing character of technology, there is much to be said for a proportion of qualifications being obtained rather later in life and by a close integration of industrial training with college study since much of what is learned during the early years of study and training is soon out-dated. The various forms of the second way are particularly well suited to effect this.

The newly developing country has much to consider before founding a new university, especially in technology, and the system of one country is not necessarily exportable to another. Qualification by the second way demands a high degree of voluntary co-operation between industry and college. It requires, of course, established and well-equipped industrial organizations for training as well as production.

To be successful, many of the schemes necessitate a certain population density below which part-time classes are usually impossible to organize since the population within travelling distance appropriate to an evening's attendance is too small to make classes economical. In that case either short periods of full-time attendance (known as 'block release') with hostel accommodation provided or the use of correspondence courses, radio or television methods are possible solutions.

The demand for holders of the technician level of qualification is usually greater than that for the full professional qualification at university level. On the other hand the latter is sometimes more important to the life and certainly to the prestige of the country. Priority being difficult to decide, a combination of the two requirements in one institution (e.g., Milwaukee School of Engineering, Wisconsin, United States, or the Yugoslav reforms) becomes a necessary consideration.

Since the development of secondary education may be retarded in the developing countries, entrance to higher technological study on the basis of the completion of secondary education may be too impracticable and unduly restrictive in numbers. To offset this and in order to give the university a new source of supply, cross-transfer for the best full-time students in the technical college may constitute a fruitful new innovation.

Film, radio, television, micro-film and teaching machines have all now added their contribution to the means available for education. Personal contacts between teacher and student have near-substitutes in well-organized correspondence courses, in the Australian radio-school, and in television lectures. New systems of higher technological education are so constructed as to permit the total or partial use of these audio-visual aids.

New methods are in themselves incentives and change protects from boredom. But academic traditions are difficult to alter and the assimilation of new techniques is a slow process, in particular where these affect individual habits. The increasing number of students to which must be added the cost of providing accommodation and equipment have led some American colleges to adopt the four-quarter system. In this system the student normally attends three of the four 12-week quarters per year, spending the fourth one either on vacation or in works experience or both. In this way an extra 33 per cent can be accepted without additional capital cost of building or equipment and staff vacations can be protected; yet this system makes little headway so great is the reluctance to change.

The greatest change of all, however, and most discernible in the United States and the Soviet Union is that the educational process has been modified in the space of half a century from one dealing with the intellectual, highly specialized *élite* to one comprising the masses, teaching approximately 90 per cent of the population to the age of 18, and 40 per cent to the age of 22. It is this change which calls for the revision of teaching techniques and of examinations.

CHAPTER V

OBJECTIVES AND METHODS: THE CHANGING SCENE

In training young people for their future profession the nation is quite literally renewing itself. All aspects of the national life are related in some measure to the training of the adolescent, and all desirable aspects of that life should find some expression, however brief, in the course of studies offered.

It is not solely a matter of practical training for the job of today nor indeed merely a matter of theoretical or cultural study, for to some of the developing countries, the most beneficial contribution that can be made to their expanding culture is just plain, unadorned manual skill.

It is not surprising that in the matter of education and training the particular methods in use are diverse and have roots in the social and economic history of the nation. Development and change tend to be slow if only because of the multiplicity of interests involved. The State, employers' federations, trade unions, education authorities, labour authorities, and the various traditions and vested interests inherited from the past are all concerned with professional training. Their pressures on the direction of future developments are strong and not always well aligned.

Both the trade apprentice and the university student have evolved, each in their own sphere, from the social institutions of the Middle Ages. Only the middle levels of the technicians and higher technicians are modern and have little, if any, historic past. But, notwithstanding the deep-rooted traditions, there has been constant change with the result that the present system of apprenticeship is not as many maintain an anachronism. Nonetheless, the system now requires adjustment to co-ordinate with the development of automation.

Based on the information which appears under the different national headings in this study, it may be observed that even in countries like the Soviet Union or the United States where a more or less definite break with the past has been made, the systems of

education and training now in use have, after some experimentation, settled down to something not remarkably different from the systems in use in countries such as the United Kingdom where no real discontinuity of tradition has occurred for many centuries. In order to appreciate fully the strengths and weaknesses of present systems, a brief historical review is presented.

APPRENTICESHIP AND THE TRAINING OF THE SKILLED WORKER

The system of personal master-apprenticeship instruction *(artisanat)*, itself but an adaptation of the primaeval father-son tutorial relationship still practised in Asia, had its roots in the middle-class guilds or corporations of the early Middle Ages.

Where such conditions were not prevalent, as for example in Southern Italy, apprenticeship has no such traditions and consequently is not so firmly developed. Where such a way of life was strong, the present-day tradition is also strong, in such countries as the Federal Republic of Germany, Belgium and the Netherlands. In these last two control of this type of apprenticeship is still exercised by the Ministry of Middle-class Affairs (Classes Moyennes). But until the seventeenth and eighteenth centuries, control of apprenticeship was a function of the autonomous guilds and not of the State. The first European legislation (Imperial Decree) of this kind was the act of 1731 which attempted to limit the autonomy of the guilds. In France, in 1776 and again in 1791, the guilds *(corporations)* were finally eliminated. Apprenticeship *(astisanat)* was thus seriously weakened even before thet industrial revolution—mechanization and, later, electric power —had altered the whole character of modern industry.

However, some handcraft occupations including the building crafts, boot and shoe making, baking and some aspects of printing, and rural crafts have survived somewhat precariously into modern times. For these trades, the *artisanat* system in European countries, excluding the United Kingdom, makes an efficient and vigorous contribution, its usual pattern being a 3-year personal master-apprentice contract with associated evening instruction in classes which are provided under the educational authorities or at the instigation of the Classes Moyennes organization. This latter group includes both retail trades and productive crafts. In the Federal Republic of Germany the *Handwerkskammer* and in France he *Chambre de Métiers* fulfil the same supervisory functions over this kind of training. In the Federal Republic of Germany 39 per cent of apprentice training is in the *artisanat* category; in France

(1959) 52 per cent of all agreements were in this category, with the exception of those doing their apprenticeship in a *collège d'enseignement technique*. In Italy 48 per cent of agreements were in *artisanat* (omitting those training in the *scuole tecniche* and the *istituti professionali*).

Though it is still a debatable question whether apprenticeship should be followed in school, i.e., in especially maintained apprentice-training centres, or on the premises of industrial undertakings, it is generally felt that in the field of *artisanat*, the place of apprenticeship should be the master workshop. So intimate is this connexion that, once broken, the world of *artisanat* with all its traditions, artistic values and pride of craftsmanship might disappear for ever.

In the United States, the Soviet Union and the United Kingdom the distinction between *artisanat* and industrial apprenticeship was never clearly made and does not exist any longer. All apprenticeship or training of the skilled worker is regarded as one problem even though training procedures for the different crafts may differ widely.

APPRENTICESHIP IN INDUSTRY

With the advent of large-scale industry in the nineteenth century and the partial replacement of the handcrafts, a new problem of training arose. It was a long time before industry became conscious of that need and longer still before individual firms felt any obligation to train apprentices. Throughout the nineteenth century, the growing industrial sector felt assured that an adequate supply of well-trained labour would, of course, immediately follow the display of the old 'Hands Wanted' notice. For a time, due to underemployment in *artisanat* and to the growth of industrial schools which were a form of penal institution in some countries, industry was able to stave off the inevitable shortage of trained and skilled labour, as at a later stage the small industrial firm was able to ignore the problem of training by attracting labour away from the larger firms which had commenced training facilities.

In some countries, notably in Belgium, apprenticeship in industry never made any appreciable advances, with the result that the vocational and technical schools of that country (*écoles professionnelles, beroepscholen* and *écoles techniques, technische scholen*) are called upon to satisfy almost the entire industrial demand. For that reason, they are exceptionally well developed and present an unusually large number of educational opportunities' transfers and promotions, culminating in an institution such as the

université du travail (Institut Paul Pastur) at Charleroi, Hainaut.

In other countries, notably the United Kingdom and the United States, the traditions that had been built up during the centuries of guild apprenticeship (master-apprentice agreement over a lengthy period, over-all time served rather than standards reached being the requirement, and certain moral obligations seldom enforced) were somewhat artificially introduced into the new world of mass production. Only at a later date and in order to save the idea of apprenticeship from extinction did governments intervene. The American Fitzgerald Act of 1937 and the United Kingdom joint training agreements set up after the report of 1945 are of that type. The most frequent period of agreement was 4 years in the United States and 5 in the United Kingdom. Undoubtedly much good stemmed from such efforts. One such benefit was the insistence upon related instruction, that is, day or evening attendance at technical classes. This latter condition, combined in the United Kingdom with the long period of apprenticeship, opened up for the apprentice a promising avenue of up-grading to technician or higher levels, giving him opportunities for which it is hard to find a parallel elsewhere.

However, as all but its most ardent supporters would agree, apprenticeship in industry in its present form does not meet the modern demands made upon it. This fact has become so apparent in the United Kingdom that a law has been passed providing for statutory boards with legal powers to frame regulations for improved methods of training. Concurrently, the Common Market countries have had numerous conferences of experts on the subject of the harmonization and modernization of methods.

Looking back over the last 50 years, it becomes apparent that the major need, particularly in the United Kingdom, is to recognize the essential difference between old-type apprenticeship in the manual trades and the type of training necessary for modern industry, for which even the term apprenticeship may no longer be appropriate. What are these differences? On the one hand the intention of the apprentice is to become a master-craftsman in his trade. Therefore, he needs an introduction to the economics of the craft, as well as to the techniques. There will be changes in his trade during his lifetime but not, he hopes, fundamental ones, for if so the craft will disappear completely, e.g., blacksmithing. Minor changes such as the availability of new tools and new sources of raw material will not in general demand a high knowledge of science or mathematics to make use of them. The main emphasis is on hand-skill and a certain ability in human relations and business affairs.

On the other hand, although the industrial apprentice needs to acquire the hand-skills of his immediate occupation, i.e., his first employment, his objective is promotion in the new hierarchy of craftsmen, technicians, engineer-technicians and professional engineers. He is never likely to become the master since no equivalent position exists in modern industry. This continually ascending movement (*capillarité sociale* as a Belgian writer has termed it) is not merely an expression of the democratic freedom and right to climb by merit from one rank to a higher one nor is it merely a way of personal promotion for the ambitious. It is essentially an economic and organizational necessity in the structure of modern industry as an efficient means of keeping pace with change and with developing techniques. By such means recently trained personnel may occupy a higher proportion of posts and will be better acquainted with the basic processes of production than those who came in at technician or designer level directly from superior educational or technical establishments.

Whereas the craft worker of the past could expect the skill acquired in his apprenticeship to be valid all his lifetime, the training acquired by an industrial apprentice, while retaining some transferable value, will, almost certainly during the latter part of his working life, not be directly related to the machine tool of production then in use.

In other words the skill that must be acquired by an industrial trainee, even assuming that he remains in active production all his life, is of a different quality. It is as much concerned with the ability to reason as with manual skills, for the machine tool is now the precision component and not the human hand-eye, neuro-muscular system. Equal attention must therefore be given to mental development and to manual skill, for the former will last a lifetime, whilst the latter must change from time to time, aided in this by re-training courses.

There are thus two inescapable components in modern industrial apprentice training: the practical training on production and the development of adequate mental powers, the latter subdividing into specialized technical knowledge, basic science and mathematics, and general culture. How these components are best imparted is the core of present-day discussions on the relative merits of special centres of an educational nature, e.g., Swedish *verkstadskolor*, or alternatively works-based training with day-release education such as that given for a *Lehrberufe* in the Federal Republic of Germany, or a combination of the two, such as the United Kingdom block-release or sandwich system affords.

No perfect system can be devised for there are many conflicting

factors. For example, in the matter of the length of apprenticeship, the shorter periods are adequate to meet the more limited skills required for machine production, but often give inadequate time for the young apprentice to reach academic standards in technical education that permit later promotion. On the other hand the United Kingdom or United States 5-year apprenticeship with day-release gives a high standard of technical education, but seriously limits the number willing to serve such a lengthy period of training.

It would seem that in general the pattern of the future is: extended school-leaving age to 15 or 16; basic one-half to 1 year full-time vocational training in specially designed centres, closely allied as regards entry with the educational system of the country; further 1 or 2 years of industrial training in a productive works, together with day-release attendance at technical classes; and improved arrangements for short re-training courses in productive practices and for continued attendance at technical classes without loss of pay. The last factor is, at present, the neglected area in most countries, with the result that a great deal of first-class potential is wasted. Only the more progressive firms show a welcome lead in developing this form of adult education, training and promotion.

APPRENTICESHIP IN SCHOOL

The idea of giving at least handcraft training and, more recently, full productive practice in specially designed apprentice centres is not a new one. In the past century the use of 'industrial schools' as penal establishments or as philanthropic measures for assisting orphans, children of the poor, or unemployed juveniles, and at the same time providing a supply of cheap labour had created an unfortunate public image of such establishments prior to the First World War. The trade schools of Britain suffered from this reputation from their inception in 1903 to their transformation to technical schools in 1920. In the years between the wars the *écoles professionnelles* of Belgium, the *écoles de métiers* of France and other schools began to show improvement in both industrial and educational work. In the post-war years the French *centre d'apprentissage* probably gained more international renown for this type of institution than any had done before. In fact the United States vocational high school deriving from the Smith-Hughes Act of 1917 had been doing much the same work for the past half-century with an almost equal age range of 15-18 against the

French 14-17. The Netherlands *lagere technische scholen* or the former *nijverheidscholen* adopted the same pattern of immediate post-school (14 years of age) entry, as did the Italian *scuole tecniche* and the Soviet labour reserve schools. Only the Federal Republic of Germany and the United Kingdom remained almost entirely unprovided in this respect. The former country maintained compulsory and the latter voluntary day-release up to 18 years in connexion with a works-based apprenticeship.

The Swedish *verkstadskola* now commencing at 16 has 2- to 3-year courses and has developed a markedly different character. Its close relation with industry, the release of its students for substantial periods of wage-earning employment during the course and the fact that it is established within the premises of industrial firms have provided a very practical and efficient combination of educational and industrial training.

The new proposals in the United Kingdom for improved industrial training include the use of basic training centres for apprentices located either in a college or in an industry, giving a course of one-half to 1 year's duration followed by 3 years' apprenticeship in industrial premises.

In France there have been some efforts in recent years to transfer the practical part of apprentice training from the *collège d'enseignement technique* (formerly called the *centre d'apprentissage*) to the premises of industrial firms. This transfer was an attempt to relieve the pressure on accommodation in the colleges and to make the best use of the low number of teachers. So far, very little transfer has actually been effected in this direction.

One of the advantages of the educational centre as a base for apprenticeship is that a number of the pupils graduating can pass on to more advanced studies for the technician level, or return to such after industrial experience more readily than they can from the apprenticeship-in-industry pattern of training, particularly where, as in Western Europe, that is limited to 3 years after school-leaving. This is not, as some industrialists complain, leaking away a proportion of their best recruits, but is rather a necessary measure if industry is to be supplied with middle-level technicians in adequate numbers.

During the last five years in the Federal Republic of Germany the *Berufsfachschule*, full-time vocational school of 1 or 2 years' duration, from the ages of 14 to 16, has made provisions of this type.

Apprenticeship-in-school is now a permanent feature of modern training schemes for the young skilled worker. The 'either-or' argument between apprenticeship-in-industry or apprenticeship-in-school is out of date and the desirable solution is a combination

of the two. For each trade and for each country there is an optimum plan. This can only be achieved by discussion, experiment, action and observation within the confines of each trade. No general standardization can be expected, nor would be desirable.

HARMONIZATION

The increasing migration of technically qualified workers the world over and the rapidity with which the material products of technology spread through all territories has attracted world attention to the problems of drawing up equivalents of qualification and training by which an individual's ability may be assessed and recognized internationally. This question as defined by Articles 118 and 128 of the Treaty of Rome has become one of great urgency for the countries of the European Economic Community.

Certain general principles of vocational training were accepted and published by the Council of Ministers of the Community on 21 February 1963 as recommendations to the Member States. If any such general harmonization takes place, it can only do so effectively through the whole body of technical teachers in the Community. A conference of the European Association of Teachers (Association Européenne des Enseignants) was held in October 1963 on the subject of 'Technical Education—the Cement of Europe' and its recommendations were published.[1]

In such efforts at harmonization the possibility of grading various categories of skill within one trade naturally arises. The practice throughout Western Europe has been to maintain only two grades of qualification: (*a*) journeyman (*compagnon, Geselle* etc.) and (*b*) master (*Meister, brevet professionnel*, etc.). Similar qualifications exist in the United Kingdom, known as the (*a*) Craft Certificate, and (*b*) Advanced Craft Certificate of the City and Guilds of London Institute.

In the Soviet Union there are five or more classifications according to ability and skill. These grades affect wages and promotion. The individual must take an examination to acquire a higher grading. The vocational schools achieve grade 2 or 3 in an ascending scale; so that 3 and 5 might correspond to the 2-grade system of Western Europe.

There is also the problem, occurring in any scheme of harmo-

1. Association Européenne des Enseignants, Paris *Education Européenne*, no. 30, January-February 1964, pp. 9-11.

nization or standardization, of the trades themselves. In the United States and the United Kingdom apprenticeship training and qualification, whether compulsory or voluntary, covers a broad band of allied skills of one field of industry, e.g., machine-tool operation. In Western Europe and the Soviet Union qualification is usually for a specific occupation, e.g., turning, milling, fitting or shaping; or as a diesel engine mechanic rather than a general mechanic for all internal combustion engines. The present tendency in Western Europe is to give a wider training with so-called 'polyvalent' qualifications covering several associated occupations.

In the United Kingdom the number of City and Guilds skilled-worker qualifications is around 200 of which about 20 are on the commercial side. In the Federal Republic of Germany over 600 *Berufe* have been classified and in the Soviet Union they number more than 12,000. This last figure, however, includes a large proportion of non-skilled occupations and lists many skilled ones under multiple headings according to the general industry in which they are practised. Nonetheless, some 2,500 clearly different trades are classified.

A wide-range polyvalent qualification is undoubtedly desirable if only for the extra flexibility it gives to meet the changing techniques of the future. Even so, to become qualified in three skills, all of which are likely to change or die out, is not much improvement and a balance must be kept between the extension of time in early apprenticeship and the provision of re-training courses in later years. It may be that in trades like the building crafts the pattern of the future will be the following: (*a*) extended education, general and technical, full-time to 16 years; (*b*) short basic training of one-half to 1 year, partly in school, partly on site, including all possible uses of mechanical aids; and (*c*) short re-training courses (e.g., spray painting, plastic piping, new types of heating appliances, prefabricated units) as techniques develop and come into use.

The present system of binding the trainees to the acquisition and use of one manual skill, even over a wide range such as plumbing, is a powerful factor in resisting change, for who wishes to see his livelihood disappear? The greatest lack in present-day apprenticeship training is that factor which would instil in the young worker not merely a willingness to face change, but a positive desire to see techniques change and, if possible, to initiate the changes himself in order to increase productivity and to raise the national and world standards of living.

It will always be a legitimate source of pride that where manual

skill is necessary it can be performed by human hands; it should not be a source of pride that modern productive industries make demands on human-hand-skill where such can be profitably replaced by mechanization or automation, for increased productivity requires the elimination of all but residual areas of hand-skill. Here lies the essential difference between *artisanat* and the world of productive industry; consequently apprenticeship in industry, without a liberal provision for technical education, is too closely akin to mediaeval apprenticeship to meet modern demands.

The pattern of the future was well outlined by Mr. Sven Grabe, Director of the Centre d'Information et de Recherche sur la Formation Professionnelle (CIRF), a section of the International Labour Office, in an article published in October 1961.[1] He foresees a closer connexion between vocational and general education, covering together some 80-90 per cent of the age group; a possible decrease of on-the-job apprenticeship; the stressing of vocational education in the last year of the compulsory school; the introduction of polyvalent training in place of specialized occupational training; the training and re-training of adults as a normal provision and not as 'help for the needy'; equivalence in qualification and validity for adult as for juvenile training; and a new and improved form of training and research into the science and pedagogy of vocational education.

THE TECHNICIAN LEVELS

The technician is often described as coming midway between the craftsman and the engineer. He might equally well be said to stand midway between the empirical type of craft-worker, deriving an existence and character from past generations, and using mostly natural-grown materials, and the future type of skilled worker, using tools which supply all the skill and automative devices which supply some of the control 'brains' but ready himself to step in when the system requires re-starting or readjustment. The technician of today must be ready to exercise both manual skill and control 'brains' and to put into practice the designs of the professional engineer.

Much depends on the industry and occupation but in general two grades of technicians are apparent. One is the skilled worker

1. 'Internationale Tendenzen in der Berufsausbildung', in: *Die Berufsbildende Schule*, October 1961, pp. 647-54.

with more advanced theoretical knowledge; the other is the higher technician or engineer-technician who has a complement of technical knowledge not far short of that possessed by the engineer and who has had more acquaintance with the productive side of his particular speciality.

Because technician training is still in the formative stage, this chapter is concerned only with the trends of its development. The comparative study of existing practices (cf. Chapter III) shows that three distinct ways are developing: (a) technical education to 16, 17 or 18, followed by practical training; (b) apprenticeship, with part-time attendance at technical classes, possibly followed by further full-time technical education (e.g., *Ingenieurschule* in the Federal Republic of Germany); or (c) some form of sandwich education-training where the two components are combined.

The first has the disadvantage that much of the advanced technical education of a practical or descriptive type, unlike the more theoretical and mathematical studies of a university degree course, is not readily appreciated or understood without prior practical experience. The second method has the converse disadvantage that much of the valuable experience derived from a well-prepared 'technician' apprenticeship (e.g., elementary machine design problems) is not possible without first reaching a moderately high level of competency in technical theory. The third method comes nearest to perfection, but breaks down badly unless the two component parts are closely integrated into a significant sequence. This, however, demands a higher degree of co-operation between college and industry than is often possible.

The technician level or levels have undoubtedly come to stay, and numerically their rate of development will exceed all other grades. The ratio of technicians to engineers is increasing, varying from 1 to 1 up to 10 to 1, according to the industry and country and averaging around 3 to 1.

Developments in university-degree courses in engineering tend to increase the amount of technological theory and to reduce or eliminate the manual skills, e.g., machine-tool operation, ground surveying, drafting, foundry practice. Consequently there is a call for a greater supply of technicians to perform such tasks, in order to release the professional engineer for research, development and design phases, for which the technician has not always the necessary mathematical or scientific training.

The situation described in Chapter IV in which the better technicians become eligible in some countries to enter upon higher technological study and acquire full professional qualification,

even at a stage later in life than normally, is obviously a trend that should be developed to the full.

In the education and training of the technician there is an important field open for educational research and planning. Manual skill in particular should be treated in a manner perceptibly different from that employed in the case of a skilled worker, for the technician is as much concerned with how a skill may be used as with exercising that skill himself. He must also be conversant with a wider range of skills than the normal skilled worker.

There should also be a marked difference between the method and procedure adopted for the technical education of a technician or higher technician and those adopted for the full engineer. The latter is in a very special category, representing less than 2 per cent of the population. Methods suitable for an *élite* are not necessarily applicable to the masses. The type of person who makes a good technician is the one who likes to form and elaborate a theory in his head after a good deal of acquaintance with the practical working of the mechanism or circuit concerned. He would prefer to prove that the angles of a triangle add up to 180° by measuring them in many shapes and then evolving a general theoretical proof. The future engineer on the other hand will be happy to accept Euclid's proof based on pure reasoning and may even consider it rather futile to check the theorem by measurement.

Unconsciously, nearly all our technical education has been based on the early development of university courses and most of the teaching staff in their work carry memories of their own technical education in universities. Considerable re-thinking and re-planning is therefore called for in connexion with technician courses. Those who have been free to experiment and have done so, disregarding (perhaps in ignorance) traditional pedagogic practices, have already achieved startling results in technician training, particularly in some of the private technical institutes of the United States. Such methods are capable of offering an educational recovery service to those for whom the normal educational system has failed to stimulate sufficient interest and ability.

The combination of skilled-worker qualification with technician speciality acquired after a course integrating theory with works experience, as provided for in *technicum* training in the Soviet Union, is also clearly an attractive and progressive programme of study providing an alternative means of livelihood for those who fail to gain final qualification at the technician level. The Soviet system of examinations like that of the United States also differs perceptibly from the Western European model.

COURSE CREDITS AND EXAMINATIONS

The two distinguishing characteristics of education in the United States are, first, its concern, even at top levels, with the masses representing 40 per cent of an age group and, second, its departure from the comprehensive final examinations as the pass/fail criterion. These two features are pertinent to technician training where the academic traditions of university practice are often irrelevant.

The whole question of examinations—their function, the qualities they test and their type of question—needs a thorough investigation with special regard to the middle levels of technical education, since storage of information by tape, microfilm, and punched card techniques has reduced the necessity for the storage of routine data in the human mind.

There were, until recently, ancient centres of academic learning (mostly in non-European countries) where great emphasis was placed on learning by rote from the classical literature of the past and where ability to recite such passages from memory was a prerequisite for success.

The testing procedure at the technician level might well be almost the inverse of this archaic procedure. Certainly some procedures have to be memorized, but these are data-processing abilities, and not data-storage requisites. As a simple example, the use of a slide rule or the equivalent computing machine is a valuable ability but the memorizing of a table of logarithms is a waste of time.

Even so, acquaintanceship with certain expressions such as formulae and their proofs may be legitimately expected as evidence of having understood the underlying theory and hence the field of application. The question of the length of time over which such memory-retention can be expected and demanded is then raised.

United States and to some extent Soviet practice places somewhat greater emphasis on the course—attendance, projects completed, periodical tests and quizzes—than upon the results of a final comprehensive examination probing all knowledge gained in the past 2 or 3 years. The memory-retention period required in some United States technical institute courses is no longer than a half-semester, or about 10 weeks. After that the knowledge acquired may not again be tested directly, although it will of course be incorporated in further studies.

In United States practice the credit points necessary for graduation are gained partly on attendance at lectures and not primarily on examinations. Course tests are scored and the grade received must not fall below certain levels for each subject and for the general average if a pass is to be earned.

The United States system is certainly better able to deal with the less academic sections of the population; probably it is also intrinsically better for the grading of technicians, who above all must be trained for action rather than for abstract thought.

The type of examination test paper is also changing. The essay-type question, which is oriented to highly charged memories, is not so appropriate as the question which calls for the handling of data in the solution of a design problem or production purpose, or for the exercise of some ingenuity in working out production methods. The better-planned technician courses show signs of using the newer and more appropriate examination methods but the others still cling tenaciously to old and unsuitable ones.

For those candidates lacking the ability to express themselves adequately, the written answer type of question puts them at a great disadvantage even though they may possess considerable technical ability. The true/false, or the multiple choice, seems to be a more suitable kind of question for students in technician training. It is not a matter of lowering standards or using 'conveyor-belt' methods of education, but rather that such techniques enable one type of student to benefit and deploy his talents in a wider field of activities than could be achieved by the older academic methods (see Appendix IV for examples).

Unlike the more literary or purely scientific studies, the cultural value in technical education is to be found not so much in the studies themselves but in the wider sphere of activity, employment, social contacts, earning capacity and national usefulness to which such studies lead an individual. It is a different, but equally desirable, form of cultural promotion; for technology is valuable as a means, rather than as an end. Indeed, technical studies are considered by some as being as effective as the older literary or scientific studies as a form of mental training and development.

TEACHERS AND THEIR TRAINING

The great expansion of technical education in the past 25 years has brought into its ranks a heterogeneous body of teachers. This has in the main been beneficial. The settled sometimes stagnant pedagogy of older forms of education has been disrupted by the flow of recruits from the world of industry and commerce. A close liaison between industry and technical education has often ensued through the transfer of staff or by the employment of part-time teachers, who are otherwise engaged in the world of industry.

Nonetheless, the problem of the ideal 'training' of the technical

teacher has yet to be satisfactorily solved. There are at least three different types of teachers or instructors whose formation has to be considered, both for full- and part-time tuition: (a) the teacher of specialized technological subjects (e.g., applied mechanics, strength of materials, hydraulics); (b) the teacher of general, cultural or scientific subjects (e.g., mathematics, history, languages) in a technical course; (c) the teacher or instructor of workshop or practical subjects (e.g., machine-tool operation, typewriting, plumbing). There will also be a variation in the level of qualification required according to the type of institution and the relevant work in which the teaching is to be given.

In the first two cases a university degree or the equivalent is usually desirable but not always obtainable. Indeed, the 'higher-technician' level of qualification is for many purposes a good substitute. Pedagogical training is required by many of the countries concerned and such training may take place before (pre-service) or during (in-service) professional employment as a teacher.

A minimum experience of 3 to 5 years in industry or commerce is usually required for teachers in the first category. This together with a requirement of full-time pedagogical training delays the teacher's entrance into the teaching profession until almost the age of 30 or upwards. Moreover, those commanding substantial salaries in industrial employment cannot reasonably be expected to enter full-time training colleges without taking a serious financial loss. Hence, the 'in-service' type of training course taken during the early years of teaching on a part-time or release basis is a convenient and useful expedient.

The third category of teacher, the workshop or practical subject instructor, is placed in a different category in many countries both for salary purposes and for teaching time. In other countries no such distinction is made on this account. Hours of work are substantially the same and there is no difference in basic salary although this grade of teacher does not normally have a university degree.

This third type of teacher is the one who most profits from pedagogic training especially oriented towards vocational education. As a skilled worker in industry he has probably not had the occasion or need to talk about his speciality. Training in teaching methods and some study of the general educational process is therefore very desirable. In most countries this is compulsory but in some it has been temporarily suspended owing to staff shortage or is on a voluntary basis as in the United Kingdom. Skilled workers going into teaching without training are expected to have had some previous teaching experience on a part-time basis and to hold

high qualifications in their trade, both in manual skill and in theory. For this type of teacher the in-service type of teacher-training course may be a useful solution to the problem since the pre-service type of course can be a powerful deterrent against recruitment from industry when a worker must give up secure employment to enter a training college, sometimes without being assured later of a teaching appointment.

In countries with a State-organized body of teachers, appointment as a paid employee is on a probationary basis upon entrance to the teacher-training college, and subject to satisfactory graduation, employment is assured. In countries like the United Kingdom where the teachers are employed by some 200 different 'local authorities', no such system is possible and the teacher has to take a chance whether upon leaving training college he will secure employment in the subject for which he has qualified, or indeed any teaching employment at all. Owing to the shortage of teachers in recent years, this risk has been minimized, but the fact that it has to be faced may well act as a deterrent against entering such training courses.

The training of technical teachers in and for countries that have only recently commenced State systems of technical education is another problem and requires methods other than those suitable for the older countries with long histories of educational development. Here the problem is concerned with speed and numbers. Training must be accelerated, concentrating only on essentials, and the breadth of knowledge may have to be diminished in order to reach a sufficiently high qualification in one speciality. Against these factors, however, there is the additional motivation given by the prospect of doing pioneer work in a responsible capacity and making a noticeable contribution to the country's welfare and technical development.

THE POLYVALENCE OF TEACHERS

Countries such as France encourage the teaching staff of the *lycées techniques* to specialize to the extent even of teaching only one subject, e.g., mathematics. Others like the Federal Republic of Germany formerly practised in the *Berufsschulen* the one-class, one-teacher type of programme in which a teacher took a group or class for all subjects on a given day. This is now giving place to the use of two separate teachers, one for theoretical subjects and one for practical. In the United Kingdom the tendency in skilled-worker training is for one teacher to take both the practice and the theory (techno-

logy) of the course of study; for a general subjects teacher to take mathematics and science; and for a possible third teacher to take liberal studies, e.g., language, civics and social sciences where these are involved. At technician levels it is common that lectures be given by individual specialists perhaps only seeing the class or group once in the day, or even in the week.

In the polyvalent system the wide responsibilities of the class-teacher in vocational or technical courses must be reflected in an equally extensive teacher-training course or much damage may result. Where countries are constrained for financial and other reasons to keep their training courses as short as possible, it would seem best to discard the notion of the polyvalent instructor and to arrange for each teacher to deploy his own talents to the best advantage in teaching his speciality and one or two closely associated subjects. In that case the co-ordinating effect of the polyvalent one-class, one-teacher system should be replaced by regular meetings of the staff teaching in any one particular course of study. Unfortunately, class schedules and other difficulties often prohibit this elementary requirement.

THE EVENING-CLASS TEACHER

The provision of evening classes in the same institution which holds full-time day classes is a normal and valuable educational facility, but it raises problems of staffing which are not easily solved. If the teachers for the evening classes do this work as paid overtime, it means that they may well be tired after a day's work with full-time pupils and therefore cannot give their best. If evening teachers do this work as part of their normal programme, they have compensatory time free during the day which means that at no time of the day are all staff avaiblable for meetings. Moreover, the principal of director will likewise not be present at all times, day and evening, for consultation.

In general the European continental countries use the first and the United Kingdom the second system described. It is difficult to find an ideal solution to this problem, simple though the facts of the situation are. Whichever system is used, there will inevitably be a large number of visiting part-time teachers. These can be of much value in creating liasions with industry and commerce, but they can also cause considerable administrative difficulty in that they are not present for conferences and staff meetings during the day since they are often employed in industrial premises, or perhaps as a general-subjects teacher at a school. Part-time staff do not fit well

into schemes of training, either pre-service or in-service, because of the high rate of turnover and because much of the pedagogic training is unsuited to the part-time teacher. No country has satisfactorily solved this problem.

THE LABORATORY ASSISTANT

Those unfamiliar with the organization of technical education are often grudging in their estimates of the required number of workshop and laboratory assistants. This is an ill-advised policy since the absence of such staff, far from saving money, is often very expensive. Not only does valuable equipment suffer, but staff teaching hours must be reduced to allow for maintenance of laboratories by the teacher. This reduction of hours is actually often a greater expense than the employment of laboratory staff, though this may not be immediately apparent.

Training courses for laboratory assistants in schools and colleges have been established in some countries but there is room for more planning since the school laboratory assistant should have different training from that of the industrial laboratory worker. Employment as a school or college laboratory assistant together with part-time study for qualifications might also be more freely used as one method of training for technical teaching.

THE TEACHING MACHINE

The advent of the teaching machine, whereby the student with the help of the programmed courses of the machine teaches himself the basic facts of the subjects, will bring up many new and interesting pedagogical problems. The teacher or lecturer will deal more and more with supervisory and guidance work rather than with the mere routine of instructing, correcting and marking. It is possible that a new type of teacher—the monitor—will become necessary as an assistant in control of the machines and of the pupils using them, especially if they are young. Again, the programme constructor must be highly trained pedagogically. These programmes could accomplish much in standardizing methods and levels of technical education on an international basis.

THE VOCATIONAL EDUCATION OF GIRLS

The General Conference of Unesco at its twelfth session adopted the following recommendation: 'Since developments in society

required from women, besides family and domestic activities for which training can be given, a much wider participation in all types of occupations, the facilities for women in technical and vocational education should be the same in importance and range as those offered to men. Men and women should have equality of opportunity for access to all types and levels of technical and vocational education. A special effort should be made in order to give to women the possibility of personal fulfilment in the vocational field through technical and vocational education.'

The skilled and productive talents of the young woman were, in agricultural and home economics, exercised at home—whether in the poultry yard, the cow-sheds, or the fields, or on the spinning wheel and the loom, in garment manufacture, or in foodstuff preservation. Her vocational education came from the family circle, and this was a wider family circle than is customary today.

Such industries are now mainly transferred to organized centres of production, whether rural processing stations for foodstuffs, or factories for industrial products. The family is naturally no longer in a position to give a complete vocational education with the necessary scientific basis. The schools or factory or both must therefore take over this role at least in part. The young woman should still have the concept of family life, the present with her parents or the future with her husband, deeply embedded in her way of thought. Any education, technical or general, that neglects this essentially feminine characteristic will probably fail to gain the whole-hearted interest of the young woman.

The vocational education of young women is not, therefore, a completely new phenomenon, as so many consider, but is in the process of being transferred from the family to the school and/or factory.

At the same time the range of occupations and services available to the young woman of today is immeasurably wider than ever before and includes some of the most rapidly expanding areas of employment, e.g., laboratory practice, dispensing, medical auxiliaries, retail trades and distribution, radio and television industries, tourist agencies and translation bureaux.

The pattern of suitable training courses for women must take into account marriage and child-bearing in their twenties, if not before, as a normal event, and not as some accidental disaster upsetting and wasting all the training that has been bestowed upon them. Some way must be sought to reconcile these two components of a woman's life which will make it possible for her to renew her professional activity in later years. The harmonization of technical education for girls in the countries of the European

Economic Community is likely to present greater difficulty than that for boys if only for the reason that social conventions as to family life, marriage, and the 'proper' place of the wife vary so greatly between the different countries. 'A woman's place is in the home' is the usual cry of those who oppose the employment of women in productive industry. They forget perhaps that the home was a centre of industrial production even up to the end of the nineteenth century and that in a few places it still is.

France has gone a long way, probably farther than any other country with the exception of the Soviet Union, in providing not only for the traditional feminine skills *(les arts ménagers)* of the home and for the needlecraft trades, cooking, hotel work, cleaning and mending, but for a whole range of imaginative, new, and eminently useful occupations, e.g., that of *assistante d'ingénieur*, in which the young woman acquires both secretarial and technical skills and thus becomes capable of acting as personal assistant to a practising engineer. At the *brevet de technicien(ne)* level, there are several courses particularly suitable for girls.

In the Soviet Union the recruiting of qualified women in industrial and technical pursuits has probably surpassed the achievements of any other country. The percentage of women employed in various occupations (1955) was as follows: public health services, 85 per cent; catering and similar work, 83; education, 68; industrial occupations, 41; constructional work, 31.

Belgium also has made much headway in the vocational education of girls and young women, not only in the vocational schools but also in basic courses integrated into secondary education. In 1958/59 out of a total of 300,000 pupils in Belgian technical and vocational education, 131,000 were girls, 73,000 of whom were over 15.

In the United States the percentage of girls graduating from high school in 1958 was slightly higher (66 per cent) than for boys (60 per cent). At the college level, 4 years later, the position was reversed (11 per cent against 22 per cent). These percentages are based on the total unit age group and not on enrolments. Whilst women graduate in large numbers in the universities, liberal arts, or teachers' colleges and enter many of the administrative professions, there are few engaged in technical pursuits concerned with production. Educational statistics under the Smith-Hughes Act for Vocational Education (trades and industry category only) show that, in 1960, out of a total of 938,490 enrolments (day and evening), 831,742 (89 per cent) were men and 106,748 (11 per cent) were women. Taking full-time day figures only, the percentages are 82 per cent and 18 per cent. For apprentices' classes, the figures

in 1960 were 135,282 (98 per cent) men and 3,903 (2 per cent) women. There is thus a large untapped reservoir of woman-power in the United States so far as technical pursuits are concerned.

This chapter, endeavouring to set out the present trends and growing points in vocational and technical education will, it is hoped, be of particular assistance to the newly developing countries. These countries, having their own different traditions and histories, can sometimes pass over one phase of development and start from the next, as for example in transport, where several countries have entirely bypassed the railway age and gone straight to air transport. Many countries likewise have passed straight to the trade-training centre for producing skilled workers and have bypassed the older phases of apprenticeship in industry or in *artisanat*. Skilled educational administrators in the developing countries will undoubtedly find other ways of improving on the older systems.[1]

1. This subject was discussed at the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, held in Geneva in February 1963. See Conference Report: 'Training: skills and techniques' in *Education and Training*, Chapter IV, Volume VI. New York, United Nations, 1963.

CHAPTER VI

COMPARISON AND SYNTHESIS

Comparative studies in technical education are a very recent development. Though comparative education has long been included in the training of school-teachers, such studies rarely made more than passing reference to technical education, and then only as a relatively unimportant fringe.

During the last 10 years particularly, technical educators throughout the world have begun to know one another and to compare the various systems in current use. Population migration and common cultural heritage had previously been powerful factors in creating 'norms' of education, general and technical, which excluded any specific attempts at standardization for political or economic reasons. The countries that were formerly part of the Union Française have inherited very strong academic traditions from the French educational system; the Scandinavian countries have similar systems and the Republics of the Soviet Union, and the countries of Eastern Europe form another self-defined area. The system in the United States has been used as a model not only by many countries of South America, but by some (e.g., Korea) where United States assistance has been available. Canada and the United States have joint working arrangements for common professional standards such as the Engineers Council for Professional Development, which accredits degree-level and technician-level courses in both Canada and the United States.

But most of these international patterns have grown up in the course of history and are unconscious incidentals to the general, social and political relations which one country enjoyed with another. The harmonization now sought for by the European Economic Community in association with other Council of Europe member States is a more accelerated process for it aims at standardizing levels of qualification in order that skilled workers may more readily migrate and form a 'European' population of a multinational character. Technical education is thus being used

as a powerful unifying influence just as postal systems, telegraphs, railways, air transport and the Coal and Steel Community crossed national boundaries to create international co-operation.

The principle of international co-operation in this field has been recognized and enjoined by Unesco on all Member States in the following terms: 'Member States should take continuous action on the preparation of programmes of international co-operation in the field of technical and vocational education. For this purpose, they should create within their own territory, a climate of opinion favourable to international co-operation. Every principal and teacher should be kept informed of what the authorities are doing to develop international co-operation in technical education and be asked to give effective aid to this undertaking.... Within each country, the first step towards international exchange of information should be to promote the systematic application of international norms relating to one or other fields of technical education, such as systems of units and scientific and technical symbols.'[1]

Technology has always crossed national boundaries more easily than have cultural, spiritual or political ideals. The education and training of technicians, technologists and skilled workers according to an identical system could therefore be a powerful international unifying influence.

Technical education more than general education has been shaped by history, social philosophy and economics, as revealed by the different patterns of apprenticeship. Now the reverse process is advocated and it is proposed that a unified pattern of technical education should help to shape the history of the participating nations and create strong ties across national boundaries.

This process has already made much headway. In many areas the technicians of the world and their works are already an important international factor. In such common projects as power generation and exchange, television networks, coal and steel production and nuclear energy development, much valuable understanding has been created and maintained.

COMMON TRENDS IN EDUCATION

The numerous educational reforms which have been enacted and implemented by various countries in the last seven years show evidence of several common trends.

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1. Unesco, *Records of the General Conference, Twelfth Session*, Paris, 1962; 'Recommendations', paragraphs 95 and 96, p. 136.

1. The division between primary and secondary education, hitherto a vertical division affected by quality, standard, class or fees paid, has become a horizontal division based on age and scholastic grade. The educational legislation enacted in the United Kingdom in 1944, in France in 1959 and in Italy in 1963 all make or confirm this change. In the Soviet Union, since 1917, and in the United States, division has been horizontal. Some countries, including several in Europe, continue to apply the older definitions of primary and secondary with the result that current educational literature can be very confusing.

2. This separation of primary and secondary education at about age 11 automatically poses the problem of the kind of secondary education which should replace the erstwhile 'primary' phase from 11 to 14 (or other school-leaving age). The more recent reforms (Sweden, 1962; Italy, 1963) have created comprehensive schools containing all intelligence levels in a unified programme of study with only a few optional subjects. Other reforms (United Kingdom, 1944; France, 1959) provided a somewhat wider choice of educational establishments with possibilities of transfer and re-transfer at the ages of 13 and 15. The Netherlands school reform proposes a similar solution. The United States and the Soviet Union both have common or comprehensive schools up to 15, after which specialization or separation into different establishments is possible, although in the United States transfer is usually deferred until after 18 years of age.

3. The integration of vocational education into the general secondary education system has been increasingly emphasized since 1945. The French *collège d'enseignement technique*, the Netherlands *lagere technische school*, the Soviet polytechnical schools, and the *technische oberstufe* of the Federal Republic of Germany are examples. The vocational high school in the United States is an older example. In the United Kingdom it is difficult to find a parallel, for the former junior technical schools are tending to die out and few secondary modern schools provide vocational trade training comparable with the countries cited.

4. Post-school full-time education of a vocational character is expanding rapidly. In the Federal Republic of Germany the *Berufsfachschulen*, the proposed new Swedish *fackskolor*, the Netherlands *uitgebreide technische scholen* and the Italian *istituti professionali* are examples. In the United States the new technician courses in high schools under the National Defense (Education) Act of 1958 and in the Soviet Union the new type *(PTU)* vocational schools are examples. The United Kingdom has not yet developed anything similar on any comparable numerical scale.

5. Full-time or part-time courses for higher-technician qualifications show the most rapid development in all countries. In France the extensions in the *lycées techniques*, in the Soviet Union the *technicum*, in the United States the technical institutes and community colleges, in Sweden the *tekniska gymnasier*, in the Netherlands the *hogere technische scholen*, in Italy the *istituti tecnici* and in the United Kingdom the Higher National Diploma courses in technical colleges, all follow the lead of the *Ingenieurschule* of the Federal Republic of Germany, the oldest educational institution at this level.

6. The merging of the administrative departments of technical education at the ministry and lower levels into the departments of secondary and/or university education reflects the above changes in the school structure. Just as the lower half of secondary education (about 11 to 14/15 years) combines with primary education of the same age range in the newer patterns, so the upper half of secondary education (about 14/15 to 19/20) combines administratively with technical and vocational education at those ages, providing an upper level of secondary education with greater diversity. The administrative office of the director of technical education survives the change as a new directorate of studies, instead of a directorate of a 'fourth estate' as it formerly was in some countries (e.g., France).

Such changes can best be studied in France in the period 1958-64 but are rapidly extending to other European countries. Italy, Belgium and the Netherlands show recent or proposed reforms for establishing this pattern of school structure. The United States system has never been otherwise and the post-1958 pattern in the Soviet Union and Eastern Europe is of the new type.

This change is completed at the third level by the inclusion of higher-technician training into the university programme at a level similar to that of the American associate degree. Such a change was proposed by the Ermini report (1963) for Italy, has already taken place in Yugoslavia and is under study in several other countries. The setting up in France in 1963 of five *écoles d'ingénieurs de fabrication*, which accept the qualification *brevet de technicien* in place of the *baccalauréat*, is a similar development at a higher level.

The days of technical education as a separate entity are over. It must now merge into the whole educational structure if education is to be adapted to the modern world.

7. Part-time study, attendance at classes or correspondence courses are means now more generally used for qualification at technician and, in some countries, at full professional engineer level. The planning and co-ordination of such means have become

essential in the opening of a complete 'second way' of education from minimum school-leaving age upwards. In the United Kingdom the City and Guilds and National Certificate routes to qualification are the best examples of this development. In the Federal Republic of Germany the *zweite Bildungsweg*, in France the *cours de promotion sociale*, and in the Soviet Union the national system of correspondence courses are similar examples of this movement.

8. The possibility of transfer from technician-training establishments, either at higher secondary technical level from a special *höhere fachschule* type of school, or from part-time studies at technician level to the technological faculties of universities without having to comply with the traditional university requirements of higher secondary education of the more academic type is being adopted by many countries. Only a few now cling tenaciously to Latin as a prerequisite of university education.

9. In all countries increasing emphasis is being placed on 'liberal studies' as a necessary complement to purely technical studies. These studies are still in an experimental stage and requirements vary considerably according to the different intellectual levels concerned.

10. In 'liberal studies', a modern foreign language now plays an important role. The congress of Trieste on the training of the skilled worker (November 1962) asked for a second compulsory language to be included in any set of requirements for a common European qualification. Without this the prospect of the 'European worker' crossing at will one or more of the national boundaries is clearly a distant ideal. At the same time some educators feel that a foreign language qualification to be held by all skilled workers is also a distant ideal except in areas which are naturally bilingual.

11. There is a widespread and ever-growing co-operation between industry and education. The most developed systems contain areas of training which are shared jointly between industrial premises or commercial offices and the vocational education establishment. Many teachers have had experience in both, some working full-time in one and part-time in the other. Numerous vocational training programmes are to be found on the premises of industry although they are subsidized by the State.

12. The techniques of teaching and examination are slowly being adapted to the different conditions of mass education, as opposed to the education of an *élite* in the older exclusive systems. The pedagogical sciences concerned with vocational education are yet young, but special training establishments for teachers in technical education are being founded in greater numbers.

13. No country can adequately consider its future reforms and

developments without a careful survey, not only of the best practices elsewhere, but also of the academic levels and educational statistics of its neighbouring countries.

THE DEVELOPING COUNTRIES

Nearly all the countries described in this study have evolved their systems of technical and vocational education concurrently if tardily with their general social and economic growth. The sum total of their effort has thus been spread over centuries.

The developing countries are faced with the much greater task of creating a completely new system, providing buildings, training or borrowing staff, enlisting suitable students with adequate previous education, gaining advice on necessary equipment, textbooks, programmes of study and levels of qualification. The problem was well defined by Dr. Ali M. Schoeb, Under-Secretary of State for Vocational Education in the Ministry of Education of the United Arab Republic, on the occasion of the international meeting of experts on technical and vocational education held in Brussels in October 1959.[1]

A developing country can be defined as a country where the following conditions prevail:

1. The human potential has not yet reached that level of qualification which enables the labouring classes to enjoy a reasonable standard of living.
2. The economy depends mainly on the export of raw materials or of semi-finished products.
3. The natural resources, other than human potential, are capable of development into industries producing goods or products which will serve to establish international economic exchanges.
4. The authorities responsible for education and training are aware of these possibilities and anxious to raise the standard of living.

Dr. Schoeb sees four basic factors in any system of technical education: the student, the instructor, the programme of study and the necessary equipment.

In addition, there are the overriding considerations of finance and timing, and human nature in any country is also susceptible to

1. De Coster Sylvain, *Technical and Vocational Education of the Youth.* Brussels, Belgian National Commission of Unesco, Ministry of Education, 1960, 224 pp. Report on the international meeting of experts on technical and vocational education, Brussels, 12 to 21 October, 1959.

prestige factors. Probably the surest and quickest way of building a strong technical education system is to start from the ground upwards. This procedure, however, may be less appealing, for it defers the academic levels of high prestige until those of lesser renown, but of often greater economic usefulness and urgency, have been satisfied. Many of the most famous institutions of today owe their present development to this procedure: the Delft Institute of Technology, the French *écoles d'ingénieurs arts et métiers* and, above all, the American Land-grant Colleges, of which the Massachusetts Institute of Technology is a brilliant example, all had more humble beginnings, and have risen in recent years to their present high level.

The American colleges which have developed along such a path have been able to provide for programmes of study of the technical-institute type within the general administration of a university or 4-year college as well as for short courses on advanced techniques.

This is a practice which many newly developing countries might follow successfully and economically, for the arbitrary division between university-level work and higher technician work in European countries results in two different buildings, two sets of equipment, and a duplicate staff of specialists. The origins are mainly historical and not always educationally advantageous. A prior study of United States or United Kingdom practice and more recently of Yugoslav reforms in the interrelation of senior technical college and university work, admission and transfers could result in much saving for a small country in the initial years of development.

The fact that a country has only recently undergone economic development generally implies that the territory has little or no modern industry. This in turn means that the practical training of apprentices and technicians has to be carried out in centres especially created for that purpose, usually under the education authorities, involving hostels and all the expenses associated with full-time education. At first this has to be accepted but it would be detrimental both educationally and financially if, as a result, the industry of the country were to be entirely relieved of its own responsibilities for training. Even in modern 'apprenticeship-in-school' systems, the need for periods of industrial training is still great.

The closest relation possible is desirable from the outset between technical staff in industry and technical staff in education. They should not be debarred from free interchange by the anomalies of some out-of-date superannuation scheme, nor made to lose in

salary or seniority for what is a normal and desirable transfer in service to their country. The executives and managers of industry must also be encouraged to take part in the self-government of technical colleges and as members of their advisory committees. The equipment of technical colleges can sometimes be drawn from industrial sources.

In the matter of training, a developing country must at first be realistic and plan its programmes to the near-minimum necessary for the occupation intended. Even countries with a century of development may not be far from this minimum. Later as economic conditions improve, a range of associated studies can be added and full educational value achieved.

Above all, the history, language, philosophy and potentialities of the developing country itself must be studied before advice is given, for as frequently remarked in this study, systems of technical education are essentially indigenous and cannot necessarily be transplanted or exported with any sure guarantee of success.

APPENDIX I

ANNEX TO THE UNESCO RECOMMENDATION CONCERNING TECHNICAL AND VOCATIONAL EDUCATION [1]

Sample schemes in full-time technical and vocational education [1]

		Length of previous education (years)	Duration of course (years)	Percentage allocation of time per subject group: General subjects [2]	Basic science subjects [2]	General technical subjects [2]	Special technical subjects [2]	Practical work in workshop or field	Qualification requirements additional to written or oral examination
Engineer or technologist		11-13	4-6	10	20-30	20-30	20-30	10-20	Thesis or project
Technicians	A	11-12	2-3	10	15	20	20	35	Project
	B	9-10	3-5	10	15	20	20	35	Project
Skilled workers		8-10	2-4	20		20		60	Practical test

1. The sample schemes relate only to full-time courses conducted entirely within educational institutions.
2. To include related laboratory or similar work.

1 Adopted by the General Conference of Unesco at its twelfth session, Paris, 11 December 1962.

APPENDIX II

SPECIMEN PROGRAMMES OF STUDY—VOCATIONAL EDUCATION

CZECHOSLOVAKIA

Apprentice training

Curriculum of 3-year training for the specialization 0422: Fitter and Mechanic [1]

Subject	Hours per week			Total hours
	First year	Second year	Third year	
Mother tongue and literature	2	2	1	200
Russian	1	1	1	120
Civics	1	1	1	120
Mathematics	2	2	1	200
Physics	2	2	1	200
Technical drawing	3	2	1	240
Materials	1	1	—	80
Technology	3	3	2	320
Machinery and plant	—	2	2	160
Organization and planning	—	—	2	80
Technical training	18	21	28	3 400
Physical education	3	2	2	280
TOTAL	36	39	42	5 400
Non-compulsory subjects				
Third modern language	2	2	2	240
Laboratory work	—	2	2	160
Sport and games	2	2	2	240

1. This training is for both boys and girls.
Source: Ministry of Education Bulletin: operative from 1 September 1962.

Curriculum for the specialization 1308: Agricultural mechanic[1]

Subject	Hours per week	
	First year	Second year
Mother tongue and literature	2	2
Russian	1	1
Civics	1	1
Mathematics	2	1
Physics	2	1
Chemistry	1	1
Physical education	3	2
Crop production	3	2
Livestock production	3	2
Engineering	1	3
Organization and economics	—	2
Workshop training	3	2
Technical training	15	18
TOTAL	37	38
Non-compulsory subjects		
Family and housekeeping [2]	3	3
Mathematics	2	2
Sports and games	2	2

1. This training is for both boys and girls.
2. Boys (metalwork, woodwork and saddlery); girls (sewing, cooking, housecraft, etc.).
Source: Stanislav Vodinsky, *Education in Czechoslovakia*, Prague, 1963, p. 39.

The above course as will be seen is of 2 years' duration only. It may be associated with an additional year in a speciality—for example, bee-keeping, poultry-farming, or on heavy farm machinery such as combines. The combined 3-year course is in effect polyvalent.

FRANCE

Curriculum of the 3-year full-time courses for boys in an industrial *centre d'apprentissage* (*collège d'enseignement technique*).

Subject	Hours per week		
	First year	Second year	Third yea
Civics, history, geography	3	2	3
French	3	3	2
Mathematics	3	3	3
Art education	2	1	1
Science and hygiene	2	2	2
Physical education	4	4	4
TOTAL (non-vocational)	17	15	15
Technical drawing	2	2	3
Workshop and technology	20	22	22
TOTAL (hours)	39	39	40

In courses for girls, 2 hours' reduction in workshop practice and 1 hour in other subject(s) provides for the inclusion of 3 hours' housecraft training in each year of the course.

The workshop practice and the technical drawing are of course based on the needs of the particular skilled trade being followed.

FEDERAL REPUBLIC OF GERMANY

Berufsschule, industrial bias, in Baden-Württemberg

Subject	Class hours			Total per week for three years
	First year	Second year	Third year	
Religion	1	1	1	3
Civics	1	1	1	3
German	1	1	1	3
Commerce	1	1	1	3
Basic technology	2	2	2.5	6.5
Arithmetic	1	1.5	1.5	4
Practical geometry	1	0.5	—	1.5
Technical drawing	2	2	2	6
TOTAL	10	10	10	30
Extra practical work up to	2	2	2	6

Example of a *Berufsfachschule* training course for girls in housecraft and needlework at the *Frauenfachschule*, Oberhausen:
Attendance: 1 year, full-time.
Entry: leaving examination from the *Realschule* or equivalent.
Qualification: the certificate at the end of the course gives the basic knowledge for further training in kindergarten and child-care work, or leads to position as forewoman in domestic services in industry.

Time-table

Subjects	Weekly periods	
	First semester	Second semester
Chemistry	2	2
Physics	1	1
Nutrition and foodstuffs	1	1
Health	2	1
Child-care	—	2
Housecraft economics	2	2
Food preparation	8	8
House, laundry and clothes	3	4
Garden work	2	—
Making and repair of clothes / Materials and tools	8	8
Religion	1	1
Writing and speech	3	3
Appreciation of art	1	1
Social science	2	2
Civics	1	1
Music	1	1
Physical education	1	1
TOTAL	39	39

ITALY

Specimen programme of studies in an *istituto professionale* for the course 'hotel office work' (*Addetto alla segreteria e all'amministrazione d'albergo*)

Subject	Hours per week		
	First year	Second year	Third yea
Religion	1	1	1
General education and civics	5	5	5
Three foreign languages, including practice	15	15	15
Trade knowledge	2	2	3
Tourist geography	2	2	2
Bookkeeping	5	2	–
Hotel administration	–	3	5
Elementary commercial knowledge	1	1	1
Hygiene	1	1	–
Typewriting	2	2	2
Physical education	2	2	2
Practical exercise in hotel work	6	8	8
TOTAL	42	44	44

An extension course of 6 months may follow.

THE NETHERLANDS

Curriculum of a lower technical school *(lagere technische school)*

Subjects	Weekly periods [1]		
	First year	Second year	Third and Fourth year
Dutch	3	5	5
English	2		
History, geography, biology	3		
Mathematics and physics	6	3	3
Technical drawing	–	6	6
Physical education	2	2	2
Workshop practice [2]	12	16	16
Optional subjects [3]	4	4	4
TOTAL	32	36	36

1. Each period is of 50 minutes.
2. General in the 1st year, specific in following years.
3. Music and/or modelling in clay and/or civics or religion.

An abbreviated example of the specification of skills drawn up for training from the Bemetel *(bedrijfsopleiding metaal- en electrotechnische industrie)* Foundation, The Hague:

Trade requirements—precision fitting (some extracts only are given)

1. Working in accordance with the safety rules and regulations.
2. Working to drawing in accordance with the specifications laid down by the Central Commission of Standardization in the Netherlands.
3. The maintenance and correct use of tools and accessories.
4. The orderly storage of tools.
5. The use of suitable cooling and lubricating media applicable to the various operations mentioned in this paper.
6. (a) Working with dividers, callipers, slide rule, interior and exterior micrometer, gauge, graphometer and final measurements;
   (b) measuring with measuring instruments reading to 1/1000 mm.
7. Lining out and making of workpieces without assistance.
8. The working and machining of the more common materials, including light metals and artificial materials.
9. Determining the operation sequence and compiling a list of tools required.
11. (a) Filing with coarse, smooth and polishing files;
    (b) filing plain flat surfaces accurately with a cross stroke;
    (c) to file flat and square:
        (i) curved surfaces, free, enclosed on one and two sides;
        (ii) flat surfaces, free, enclosed on one and two sides;
        (iii) surfaces with a minimum width of 1 mm;
    (d) filing to size of flat surfaces, free in accordance with the ISA fit 6, with a minimum of 0.01 mm;
    (e) filing to size of surfaces, enclosed on one and two sides, in accordance with ISA fit 7, with a minimum of 0.02 mm.
16. Countersinking to size holes with a cylindrical and a taper counter. bore.
20. Riveting of small rivets and pins, with a minimum diameter of 0.05 mm.
21. Bending and straightening of light material, cold.
22. (a) Soldering with copper and silver;
    (b) brazing of steel and copper;
    (c) the correct use of fluxes.
24. Case hardening, annealing, hardening and tempering of workpieces.
27. Operating the lathe (detailed description).
28. Operating the shaping machine (detailed description).
29. Operating the milling machine (detailed description).
30. Operating the surface grinding machine on elementary operations.
32. Dismantling:
    (a) dismantling in the correct sequence and putting away (for storage if necessary) of all parts.

Other propositions may be added in accordance with the requirements of the firms concerned (detailed description).

SWEDEN

A 2-year commercial office training course for those who have completed their basic education to 16 years

Subject	Average weekly periods	
	First year	Second year
Compulsory subjects		
Swedish and business correspondence	5	4
English	5	5
Bookkeeping	4	4
Commercial calculations	5	5
Commercial knowledge	2	3
Office practice	2	2
Economic geography	2	2
Social studies	—	2
Typewriting	5	5
Handwriting and engrossing	1	—
Physical education	2	2
TOTAL[1]	33	34
Optional or extra studies		
Additional English	2 — 3	2 — 3
German	3 — 4	3
Shorthand	2 — 3	2 — 3
Extra typewriting	1	1
Machine calculations	—	1
Window dressing and poster-writing	1 — 2	1 — 2

1. The compulsory total for both the first and second years is 37 periods per week.

New type (*PTU*) vocational school, 3-year course for the training of instrument fitters.

	Hours
Practical instruction, in school	1 611
Practical instruction, in productive industry	1 354
TOTAL	2 965
Special technology	421
Tolerances and technical instruments	78
Technology of metals	117
Mechanics	156
Electrotechnics and electronics	121
Mathematics	112
Mechanization and automation	108
Organization and economics of production	48
Social science	182
Physical education	188
Arts and aesthetics, optional	188
TOTAL	1 719

Individual and team training in the trade of electrical fitter, for the installation of power equipment. Duration of course, approximately six months.

Practical	Days
Practical work, basic instruction	2
Experience in installation of power equipment, second category	98
Simple installation work by the apprentice	49
Qualification test	1
TOTAL	150

Theoretical	Hours
Basic technical knowledge	2
Construction and organization	4
Safety, hygiene and fire precautions	10
Use of materials	20
Reading of drawings	24
Electrotechnics	40
Installation procedure: industrialization and mechanization	12
Installation of power equipment	66
Organization and management of construction	10
Revision and registration	4
TOTAL	192

Three year vocational school for automatic lathe operators.[1] Curriculum analysis over the 3 years:

Vocational and technological subjects	Hours
Industrial training	2 974
Machine tools, theory of metal cutting	161
Technology of automatic turning	259
Tolerances, fits and measurements	78
TOTAL	3 472
General educational subjects	
Mathematics	112
Technology of metals	112
Technical mechanics	156
Technical drawing	156
Electrical science and engineering	126
Mechanization and automation of production	108
Organization and economics of production	48
Physical education	188
Social studies	188
Aesthetic education	188
TOTAL	1 382
GRAND TOTAL	4 854

UNITED KINGDOM

Programme of mechanical engineering craft practice course [2]

The scheme is divided into two parts, I and II, followed by optional supplementary studies of a more specialized nature. The purpose of the course is to supplement but not replace the industrial training of the craft apprentice and thus assist him to reach both practical proficiency in fitting, turning and machinery, and to acquire a basic theoretical knowledge of science and technology.

Each of the courses for Part I and Part II should occupy between 500 and 650 teaching hours over 2 years of part-time day, or 3 years of eve-

1. U.S.S.R. Council of Ministers, State Committee for Vocational and Technical Education. *Vocational and Technical Education in the U.S.S.R.* Moskva, 1962 p. 48.
2. City and Guilds Syllabus No. 193.

ning study. At least 60 per cent of the time should be spent in the workshops. The supplementary course after Part II should occupy 250 to 325 hours.

The subjects of the course include: craft practice, active workshop practice (4 or 5 hours); craft theory, partly in the workshop, partly in the class-room (1 or 2 hours); related studies, mainly science and calculations (1 hour); general studies, including letter-writing, civics, spelling, use of leisure, local industry, factory regulations, etc. (1 hour); a total of 8 hours per week.

Examinations are set at the end of Part I (2 years) and Part II (4 years) on (a) craft practice, 20 hours' test of workshop practice; and (b) craft theory and relation studies.

No examination is set in the subject 'general studies'.

The supplementary 1-year course is tested by two written papers, without practical examination. This programme enables the candidate to specialize in either (a) fitting processes, (b) machinery processes, or (c) toolmaking processes.

UNITED STATES OF AMERICA

Examples of apprentice training schemes

Toolroom machinist. Practical training with AC Spark Plug Co. (General Motors). The following schedule is set up as a guide, subject to working conditions:

Work	Hours	Work	Hours
Tool crib	120	Grinding:	
Lathe:		External	320
engine	2 000	Internal	120
turret	480	Surface	120
Milling machine	2 120	Cutter	120
Drill press	200	Thread	40
Shaper	160	Inspection	280
Plane	120	Miscellaneous machines	968
Jig bore	80	Related instruction	672
Heat treatment	80	(see below)	
		TOTAL	8 000

Related instruction, at Milwaukee Vocational School: the apprentice attends the school for 672 hours, one day per week for 84 weeks, from 7·55 a.m. to 4.15 p.m.

Subject	Hours	Subject	Hours
Technology:		Science:	
Basic machine tools	54	Machine shop science	54
Machine shop technology	16	Related shop:	
Jig and fixture technology	36	Basic heat treatment	36
Press tool technology	38	Inspection and testing	36
	144		72
Mathematics:		Apprentice problems:	
Machine shop mathematics	60	Job relations	27
Essentials of trigonometry	28	Economic relations	27
Applied trigonometry	56		54
	144		
Drawing:			
Fundamentals, tool design	60		
Jig and fixture design	60	GRAND TOTAL	672
Blueprint reading	18		
Advanced blueprint reading	60		
Die design	6		
	204		

Apprentice training course in drafting. This form of apprenticeship with the General Electric Co. is selective and has two divisions, A and B. The latter is at the higher standard and leads to the associate degree, as well as possible scholarships or loans for subsequent study to full professional level. Only the B programme is detailed here.

Shop training, 40-hour week.

	Hours
First year: Apprentice shop.	
Production work on lathes, millers, grinders, drills, shapers and bench work.	2 000
Second year: Apprentice shop.	
Tool jig and fixture making. High precision machine work.	1 834
Apprentice drafting room. Drafting, orientation in drawing sizes, lettering, dimensional and finish symbols, projection in tracing	166
Third year: Any department.	
Detailing of tool, die, jig, fixtures, test equipment and/or production parts and assemblies	2 000
Fourth year: Same	2 000
	8 000

Drafting apprentice. Academic programme. Tuft's University, Medford, Massachusetts. Attendance 5 p.m. to 8 p.m. Monday, Wednesday and Friday from September to June.

Year	Semester	Subject	Hours	Credits
First	First and second	General chemistry	91	6
		Engineering graphics	91	4
		Engineering mathematics	91	6
Second	First and second	Calculus	91	6
		General physics	91	6
		Composition and literature	91	6
Third	First	Differential equations	48	3
	First and second	General physics	91	6
	First and second	Applied mechanics	91	6
	Second	General economics	43	3
Fourth	First	Electric circuits	48	3
		Thermodynamics	48	3
		General economics	48	3
		Electronic circuits	43	3
		Fluid dynamics	43	3
		Introduction to machine design	43	3
		TOTAL	1 092	70

On successful completion of this course, the Associate in Science degree is awarded.

The curricula of a vocational high school for girls, New York (programme in beauty culture) and a vocational high school for boys are shown on the following pages.

Curriculum of a vocational high school for girls, New York. Programme in beauty culture (in periods per week)

Group	Subject	Ninth year		Tenth year		Eleventh year		Twelfth year	
		Term A	Term B	Term A	Term B	Term A	Term B	Term A	Term B
I. Constants	English	5	5	5	5	5	5	5	5
	Social studies	5	5	—	—	5[1]	5[1]	5[2]	5[2]
	Science (General)	5	5	—	—	—	—	—	—
	Mathematics	5	5	—	—	—	—	—	—
	Physical education	2	2	2	2	2	2	2	2
	Health instruction	—	—	—	—	2	3	—	—
II. Required shop subjects	Exploratory shops	10	10						
	Beauty culture	—	—	20	20	20	20	20	20
III. Required related subjects	Related art	—	—	2	3	—	—	—	—
	Mathematics (Basic)	—	—	5	5	—	—	—	—
	Science (Basic)	—	—	5	5	—	—	—	—
	Cosmetology (related technology)	—	—	—	—	5	5	5	5
Other subjects	Art (Basic)	2	2	—	—	—	—	—	—
	Driver education	—	—	—	—	—	—	1	—
	Economics	—	—	—	—	—	—	2	2
	Music	1	1	1	—	1	—	—	1
TOTAL		35	35	40	40	40	40	40	40

1. World history.
2. American history.

Curriculum of a vocational high school for boys.[1] Admission at 15; length of course: 3 years

Subject	Number of periods[1]		
	First year	Second year	Third year
Workshop practice	20	20	20
English	4	4	4
Mathematics	2	4	4
Science	2	4	2
Technical drawing	4	—	2
History and citizenship	4	4	4
Health education and military training	4	4	4
TOTAL	40	40	40

1. The periods are of 45 minutes each, thus making 30 hours per week.

1. Alexander Graham Bell Vocational School, Washington, D.C.

Example of a 3-year full-time vocational school with associated practical workshop training

Admission is on the basis of 8 years of elementary education. The practical work is arranged in local industries, building sites, farms, and/or in the school workshops.

Example of a course for metal workers

Subjects	Weekly periods		
	First year	Second year	Third year
Mother tongue	2	2	2
Mathematics	3	2	2
Civics and Yugoslav economy	—	2	3
Physical education	2	2	2
Pre-military education	—	2	2
Applied mechanics	2	2	2
Technical drawing	3	2	2
Machines, machine tools and machine-production	3	4	3
Elementary electrotechnics	2	—	—
Total theoretical subjects	17	18	18
Practical instruction	24	24	24
TOTAL	41	42	42

After this training, the pupils go into their industrial employment, and may continue their studies for the grade of highly skilled worker or technician by attending evening classes.

APPENDIX III

SPECIMEN PROGRAMMES OF STUDY—TECHNICAL EDUCATION

CZECHOSLOVAKIA

Secondary vocational schools—technical

Curriculum for engineering technology

Subject	Hours per week				
	First year	Second year	Third year	Fourth year	Total
Mother tongue and literature	3	2	2	2	9
Russian language	2	2	2	2	8
History	2	2	—	—	4
Economic geography	—	—	2	—	2
Civics	1	1	1	1	4
Mathematics	5	3	3	—	11
Physics	4	—	—	—	4
Chemistry	4	—	—	—	4
Political economy	—	—	2	—	2
Electrical technology	—	3	2	—	5
Technical drawing	4	2	—	—	6
Mechanics	—	5	3	—	8
Machine details	—	6	5	—	11
Theory of machines	—	—	4	8	12
Technology	3	3	3	8	17
Organization and economics	—	—	—	4	4
Laboratory work	—	—	—	4	4
Workshop training[1]	5	4	4	4	17
Operational training[1]	—	—	—	1	1
Physical education	3	3	3	2	11
TOTAL	36	36	36	36	144
Non-compulsory subjects					
Third modern language	2	2	2	2	8
Mathematics	—	—	—	2	2
Physics	—	—	2	—	2
Sports and games	2	2	2	2	8

1. With 3 additional weeks' full-time experience after the first, second and third years.

Curriculum of the secondary school for young workers (periods per week)[1]

Subject	Specialization															
	Physics				Chemistry				Biology				General education			
Mother tongue and literature	2	2	2	6	2	2	2	6	2	2	2	6	2	2	2	6
Russian	2	2	1	5	2	2	1	5	2	2	1	5	2	2	1	5
Civics	1	—	—	1	1	—	—	1	1	—	—	1	1	—	—	1
History	—	1	1	2	—	1	1	2	—	1	1	2	—	1	1	2
Geography	—	—	1	1	—	—	1	1	—	—	1	1	—	—	1	1
Mathematics	4	3	4	11	4	3	4	11	4	3	4	11	4	3	4	11
Descriptive geometry	—	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—
Physics	2	3	3	8	2	2	2	6	2	2	2	6	2	2	2	6
Chemistry	1	1	1	3	1	3	2	6	1	1	1	3	1	1	1	3
Biology	—	—	1	1	—	1	1	2	—	3	2	5	—	1	1	2
Technical instruction	3	4	4	11	3	4	4	11	3	4	4	11	3	4	4	11
Optional subject	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	3
TOTAL	15	18	18	51	15	18	18	51	15	18	18	51	15	18	18	51
Non-compulsory subject (modern language, descriptive geometry, art, music, Latin, etc.)	2	2	2	6	2	2	2	6	2	2	2	6	2	2	2	6

1. The school time-table has a maximum of 16 hours per week.

Source: Vodinsky, op. cit.

FRANCE

Technician courses in lycées techniques

Shown below is the curriculum leading up to the diploma *brevet de technicien* (T.1). Admission into grade 2 is at about 15 years from the *collèges d'enseignement général* or *lycées modernes*. At present the applicant must pass a competitive examination, but a proposed reform will make a satisfactory school record the criterion for admission.

Subjects	Hours per week				
	Fourth grade	Third grade	Second grade	First grade	T.1
Mathematics	5	4	5	3	2
Sciences	4	4	2(4)[1]	1	2
Mechanics	—	—	1	3	2
Electrotechnics	—	—	1	2	2
French language	6	4	3	2	1
History, geography, civics	4	2	2	—	—
Modern language	4	3	2(3)[1]	2	1
Art drawing	2	2	1	—	—
Economics	—	—	—	—	1
Drawing and design	3	3	4	5	5
Technology	1	3	3(2)[1]	4	4
Workshop	4	10	12(10)[1]	14	16
Physical education	4	4	4	4	4
TOTAL	37	39	40	40	40

1. The figures in brackets are revised hours in operation since the 1964/65 school year (cf. *Journal Officiel*, 19 July 1964).

Where the school is integrated into the 11-15 common programme of the *collège d'enseignement secondaire, premier cycle*, the fourth and third years may contain less technology and more general instruction, this being balanced by adjustment in the later years.

There is an extension course of 2 years full-time following the 5-year (13-18) or 3-year (15-18) *technicien* course, for the *brevet de technicien supérieur* (T.S.1. and T.S.2). The curriculum of studies has a common base of 10 hours for all students, plus a distinctive and specialized programme of 27 hours for the speciality concerned, making a weekly total of 37 hours (see onerleaf).

Subject	Hours T.S.1.	Hours T.S.2.
Common programme		
French, economics and humanities	3	3
Modern language	2	2
Physical sciences	2	2
Mathematics	2	2
Works organization	1	1
TOTAL	10	10
Special Programme[1]		
Mathematics	2	2
Mechanics and materials	1	1
Reinforced concrete	1	1
Surveying	2	1
Drawing and design	7	7
Construction	4	5
Work on site	6	6
Quantities and measurement *(métré)*	2	2
Art and architecture	2	2
TOTAL	27	27
GRAND TOTAL	37	37

1. Building has been taken as an example of a special programme.

FEDERAL REPUBLIC OF GERMANY

Junior technician course[1]

Example of a *Fachschule* programme, full-time or evenings.
Purpose: the training of junior industrial technicians (*Betriebstechniker*).
Attendance: day (two semesters each of 20 weeks; 36 periods per week) or evening (six semesters each of 20 weeks; 12 periods per week). Total instruction periods in each case: 1,440.

1. Supplied by Bochum *Fachschule*.

Entry: skilled-worker qualification, and 1 year further experience in a related craft; or final examination of the *Realschule* plus 2 years' practical experience; or the *Fachschulreife;* or *Anlernling* training plus 2 years of practical experience. An entrance examination is also imposed.
Qualification: by State examination as *Betriebstechniker.*

Subjects	Weekly periods of study in each semester						Total (in six semesters)
	First	Second	Third	Fourth	Fifth	Sixth	
General							
German	1	—	1	—	1	—	3
Knowledge of industry		1	—	1	—	—	2
Basic technical							
Mathematics	2	2	2	—	—	2	8
Descriptive geometry	—	2	2	—	—	—	4
Physics and chemistry	2	—	—	—	—	—	2
Applied heat	2	—	—	—	—	—	2
Mechanics	—	—	1	2	1	—	4
Strength of materials	—	—	1	1	2	2	6
Electrotechnics	2	2	—	—	2	—	6
Power installations	—	—	2	—	—	—	2
Materials and testing	1	2	—	—	—	—	3
Machine tools	—	1	1	2	2	2	8
Metrology	2	—	—	—	—	2	4
Industrial subjects							
Technical statistics	—	—	—	2	—	—	2
Applied nomography	—	—	1	2	2	2	7
Work study	—	—	1	2	2	2	7
Work	—	2	—	—	—	—	2
TOTAL	12	12	12	12	12	12	72

Example of a six-semester *Ingenieurschule* programme in the course for *Maschinenbau* (mechanical engineering).
Purpose: the training of higher technicians (*Ingenieur*).
Attendance: full-time day, 3 years.
Entry: *Fachschulreife* or *Mittlere Reife* with prescribed practical training in each case.

Subject	Periods of study in each semester[1]					
	First	Second	Third	Fourth	Fifth	Sixth
English	—	—	—	2	2	2
Economics	—	—	—	2	2	2
Other general subjects	—	—	—	2	2	2
Mathematics	8	8	4	—	—	—
Physics	4	2	4	—	—	—
Applied mechanics	6	6	6	—	—	—
Thermodynamics	—	—	4	—	—	—
Basic electrotechnics	—	—	2	2	—	—
Chemistry and materials	6	4	4	—	—	—
Production techniques	4	4	2	—	—	—
Machine design and metrology	8	12	10	—	—	—
Kinematics	—	—	—	2	2	—
Industrial production	—	—	—	6	4	4
Steam engines	—	—	—	2	2	—
Steam turbines	—	—	—	—	2	2
Heat engines	—	—	—	4	2	2
Hydro-turbines	—	—	—	—	—	2
Machine tools of production	—	—	—	4	4	2
Theory of heat exchanges	—	—	—	2	2	2
Heat laboratory	—	—	—	4	2	4
Cranes and structures	—	—	—	4	4	4
Electrotechnics	—	—	—		6	6
Cybernetics	—	—	—	—	—	2
TOTAL	36	36	36	36	36	36

1. Weekly periods of 50 minutes.

Example of a 5-year full-time technician-level course in nuclear energy taken from the programme of the Istituto Tecnico Feltrinelli, Milan.

Subjects	Weekly periods of study					Total	Examination[1]
	First year	Second year	Third year	Fourth year	Fifth year		
General subjects							
Religion	1	1	1	1	1	5	—
Italian	5	5	3	3	3	19	W.O.
History and civics	2	2	2	2	2	10	O.
Geography	3	—	—	—	—	3	O.
Mathematics	5	4	—	—	—	9	W.O.
Physics	3	3	—	—	—	6	O.
Science	—	3	—	—	—	3	O.
Chemistry	—	3	—	—	—	3	O.
Technical drawing	6	4	—	—	—	10	g.
Foreign language	3	3	—	—	—	6	W.O.
Foreign language (technical)	—	—	2	—	—	2	O.
Law and economics	—	—	—	—	2	2	O.
Specialist subjects							
Mathematics	—	—	4	4	—	8	W.O.
Organic chemistry	—	—	3	—	—	3	O.
Atomic physics and instrumentation	—	—	4	3	4	11	O.p.
Electrotechnics and measurements	—	—	8	3	—	11	W.O.p.
Electronics and nuclear measurements	—	—	—	8	9	17	W.O.p.
Nuclear plant and related technology	—	—	—	2	4	6	O.
Control and servo mechanisms	—	—	—	—	4	4	O.p.
Mechanics and machines	—	—	3	2	—	5	O.
Technical design	—	—	2	4	3	9	g.
	28	28	32	32	32	152	
Practical subjects							
Workshop	6	8	4	4	4	26	p.
Physical education	2	2	2	2	2	10	p.
TOTAL	36	38	38	38	38	188	

1. Abbreviations employed in this column:
W.O. = written and oral; O. = oral; g. = graphic; p. = practical.

THE NETHERLANDS

Curriculum of a higher technical school, *hogere technische school* (*HTS*), leading to the award of a higher technician diploma after a course in mechanical engineering.

Subjects	Weekly periods[1]			
	Prep. year	First year	Second year	Fourth year[2]
Dutch	2	1	—	—
English	3	1	1	1
German	3	1	1	1
Civics	2	1	—	1
Physical education	2	1	1	1
Industrial organization	—	—	2	3
Optional subjects	4	—	—	—
Mathematics	7	6	3	1
Strength of materials	—	3	4	2
Physics and heat	5	3	3	1
Chemistry	—	2	2	—
Construction	—	6	9	13
Electrotechnics	—	—	—	2
Technical drawing	4	8	7	13
Workshop practice	4	6	6	—
TOTAL	36	39	39	39

1. Periods of 50 minutes each.
2. The third year is spent in industrial practice.

SWEDEN

The following are examples of two 3-year full-time courses in a *tekniskt gymnasium* in (a) mechanical engineering; (b) telecommunications.
Entry: at 16 years upwards having achieved the necessary leaving standard from the (old) *realskola*, or (now) *grundskola*, and after selective entry to the *tekniskt gymnasium*.

Curriculum

Subject	Year		
	First	Second	Third
Mechanical engineering:			
Mathematics	9	5	—
Physics	6	6	—
Chemistry	6	—	—
Technical drawing	4	—	—
Projection geometry	2	—	—
Swedish	3	3	1
English	3	2	1
German	3	2	—
Physical education	3	2	0.5
Mechanics	—	4	—
Strength of materials	—	4	—
Machine design	—	8	2
Properties of materials	—	3	—
Applied heat and power	—	—	11
Workshop	—	—	9
Electrotechnics	—	—	4
Modern history and civics	—	—	4
Industrial economics	—	—	4
Industrial psychology	—	—	1
Periods per week	39	39	37·5
Telecommunications:			
Mathematics	9	5	—
Physics	6	3	—
Chemistry	6	—	—
Technical drawing	4	—	—
Projection geometry	2	—	—
Swedish	3	3	1
English	3	2	1
German	3	2	—
Physical education	3	2	0.5
Mechanics	—	3	—
Strength of materials	—	2	—
Prime movers	—	3	—
Materials and workshop	—	2	—
Electrotechnics	—	9	—
Electronics	—	3	5
Electrical power	—	—	4
Line communications	—	—	8
Radio communications	—	—	9

Subject	Year		
	First	Second	Third
Modern history and civics	—	—	4
Industrial economics	—	—	4
Industrial psychology	—	—	1
Periods per week	39	39	37·5

At the conclusion of the course, the students take the *ingenjörsexamen* which makes them eligible for entrance to the *tekniska högskola*—the institute of technology at university level.

The new 4-year technical gymnasium[1]

Admission at 16+ from the comprehensive school *(grundskola)* having successfully followed in the ninth year the appropriate pre-*gymnasium* studies.

All technical 'lines' of study will have a common core of general and basic technical subjects. Only the 'special technologies' will vary between the various technical 'lines' such as mechanical, electrical, building, chemical, etc.

Subject	Weekly periods				Total
	First year	Second year	Third year	Fourth year	
Swedish	3	3	2	—	8
English	3	2	—	—	5
Second foreign language	3	3	—	—	6
History	2	2	—	—	4
Ergonomics	—	—	—	2	2
Civics	3	—	2	—	5
Mathematics	5	5	6	—	16
Physics	2·5	4	4	—	10·5
Chemistry	2·5	4	—	—	6·5
Technology	6	5	—	—	11
Industrial economics	—	—	—	3	3
Physical training	3	3	2	—	8
Optional time	1	1	1·5	—	3·5
TOTAL (common core)	34	32	17·5	5	88·5
Special technologies	—	—	12·5	29	41·5
TOTAL	34	32	30	34	130

1. Sweden, Kungl. Ecklesiastikdepartmentet, *Läroplan för Gymnasiet*, Stockholm, 1963, p. 58.

The special technologies for the mechanical engineering line for the third and fourth years are detailed below:

Subject	Weekly periods		
	Third year	Fourth year	Total
Construction	5·5	5·5	11
Energy	2	5	7
Production	3	7·5	10·5
Control systems	—	4	4
Electrotechnics	2	2	4
Practical work	—	5	5
TOTAL (special technologies)	12·5	29	41·5

The new fackskola[1]

Proposed time-table for the technical *fackskola*, common core for all technical lines, building, mechanical, electrical, chemical, etc.

Subject	Weekly periods	
	First year	Second year
Swedish	4	—
English (or German)	3	—
Civics	—	2
Physical training	3	2
Maths., physics, chemistry	12	6
Ergonomics	—	2
TOTAL (common core)	22	12
Special technical subjects	13	23
TOTAL	35	35

As an example, the special technical subjects for building (subsection 'House construction') are given below.

1. Sweden, Kungl. Ecklesiastikdepartmentet, *Fackskolan*, Stockholm, 1963, p. 292.

Subject	Weekly periods	
	First year	Second year
Building science	7	—
Building construction	6	4
Production and organization	—	6
Building plans	—	3
Building design	—	4
Materials and structures	—	3
Roads, drainage, etc.	—	3
	13	23
TOTAL(common core)	22	12
	35	35

UNION OF SOVIET SOCIALIST REPUBLICS

Curriculum of a full-time *technicum* course for the qualification of technician in the specialization 'Boilers'.

Admission: after completing the eighth year, i.e., 'incomplete' secondary school.

Duration: 4 years 4 months including (a) works experience to gain a skilled-worker qualification and qualify in the special technology, and (b) preparation of the final diploma project.

Year	Semester	Subject	Weeks
First year	First semester	College study	19
		Vacation	2
	Second semester	College study	17
		Examinations	2
		Practical training[1]	4
		Vacation	8
TOTAL (First year)			52
Second year	Third semester	College study	16
		Practical training[1]	3
		Vacation	2
	Fourth semester	College study	18
		Examinations	2
		Practical training[1]	3
		Vacation	8
TOTAL (Second year)			52
Third year	Fifth semester	College study	14
		Examinations	1
		Practical training[1]	4
		Vacation	2
	Sixth semester	College study	13
		Examinations	2
		Practical training[1]	8
		Vacation	8
TOTAL (Third year)			52
Fourth year[2]	Seventh semester	College study evening	20
		Examinations	1
		Works experience	20
	Eighth semester	College study evening	20
		Examinations	1
		Works experience	26
		Vacation	4
TOTAL (Fourth year)			52
Fifth year (part)	Ninth semester	Works experience[3]	9
		Diploma project	8
			17

1. To gain a skilled-worker qualification.
2. In practical work.
3. To qualify in the special technology.

During works employment, the student attends 12 hours of classes per week or takes correspondence courses.

The subjects of study and the hours allotted to each are as follows:

Subject	Session[1]	Hours		
		Theoretical	Practical[2]	Total
General education section				
History of the U.S.S.R.	1, 2, 3, 4	159	—	159
Fundamentals of political knowledge	5, 6	93	—	93
Economic geography	3	64	—	64
Literature	1, 2, 3, 4, 5	223	—	223
Mathematics	1, 2, 3, 4	404	—	404
Physics	1, 2, 3	178	36	214
Chemistry	1, 2	96	32	127
Foreign language	1, 2, 3, 4, 5, 6	176	—	176
				1 460
Basic technical section				
Technical drawing	1, 2, 3, 4	45	200	245
Mechanics	3	128	—	128
Strength of materials	4	80	10	90
Machine details	5	97	15	112
Technology of metals	2	86	16	102
Electrotechnics	3, 4	90	32	122
Basic electronics	6	66	12	78
Thermodynamics and hydraulics	4	64	8	72
				949
Special technology				
Foundry practice	3	40	8	48
Press fabrication	4	54	—	54
Welded construction	5	74	10	84

The subjects of study and the hours allotted to each are as follows *(contd.)* :

Metal-cutting and tools	4, 5, 6	136	20	156
Technical measurements	5	46	10	56
Technical thermodynamics	4, 5	102	12	114
Loads and transport	7	68	12	80
Steam boilers and installations	5, 6	137	36	173
Regulation and control of boilers	8	68	12	80
Technology of boiler construction	6, 7, 8	146	46	192
Economics and organization	7, 8	88	12	100
Technical standards	7	40	—	40
Safety and fire precautions	8	40	—	40
Supplementary academic knowledge	1, 4, 6	100	—	100
				1 317
Physical training	1, 2, 3, 4, 5, 6	246	—	246
TOTALS		3 433	539	3 972[2]
Optional subjects				
Russian	1, 2	—	—	55
Physical training	1, 2, 3, 4, 5, 6	—	—	97
Tutorials, special subjects	7, 8	—	—	80

1. The figures under this heading indicate semesters during which the subject is studied.
2. Time allocated to project work has been listed above under 'practical'. The hours of instruction per week during the first three years are 36, except in works where there is no concurrent academic instruction. During the fourth year, in works, the student attends 12 hours per week at evening classes for 40 weeks in the year.

The following is the curriculum of a 2-year *technicum* course in 'Industrial and civil construction'.
Admission: after completion of full secondary education.
Duration: 2 years 10 months, including (a) works experience to gain a skilled-worker qualification and qualify in the special technology, and (b) the time necessary for the final diploma project.
The sequence of studies is:

Year	Semester	Subject	Weeks
First year	First semester	College study	15
		Practical training[1]	4
		Vacation	2
	Second semester	College study	16
		Examination	2
		Practical training[1]	2
		Surveying field-work	3
		Vacation	8
TOTAL (First year)			52
Second year	Third semester	College study	15
		Practical training[1]	4
		Vacation	2
	Fourth semester	Practical training[1]	8
		Works employment	14
		Examination	1
		Vacation	8
TOTAL (Second year)			52
Third year	Fifth semester	Works employment	19
		Vacation	2
	Sixth semester	Works employment	8
		Examination	1
		Practical training[2]	6
		Diploma project	8
TOTAL (Third year)			44

1. To gain a skilled-worker qualification.
2. To qualify in special technology.

During works employment, the student attends 16 hours of evening classes per week or takes correspondence courses.

The subjects of study and the hours allotted to each are as follows:

Subject	Session[1]	Hours[2]		
		Theoretical	Laboratory	Total
General education section				
Political and civic economy,	1,2	92	—	92
Fundamentals of higher mathematics	1	90	—	90
				182
Basic technical section				
Technical drawing	1, 2	60	141	201
Applied mechanics	1, 2, 3	253	8	261
				462
Special technology				
Construction materials	1, 2	100	24	124
Electrotechnics	1, 2	112	28	140
Surveying and setting out	1, 2	50	28	78
Civil and industrial buildings	2, 3	161	72	233
Fundamentals of welding	3	52	8	60
Construction equipment	3	100	20	120
Sanitary engineering	3	59	16	75
Safety and fire precautions	3	41	4	45
Organization of construction	3, 4, 5	182	74	256
Building construction	4, 5, 6	198	60	258
Estimates and costings	5, 6	66	20	86
Economics of construction	5, 6	66	20	86
				1 561
Physical training	1, 2, 3	107	107	107
TOTALS		1 789	523	2 312
Optional extra				
Foreign language	1, 2, 3	123	—	123
		1 912	523	2 435

1. The figures under this heading refer to the semesters during which the subject is studied.
2. Project time includes hours for laboratory work, etc. The total hours per week are 36 when in the college, and 16 hours per week (evening classes) for the works employment periods. If a foreign language is taken, attendance is increased to 39 hours per week.

The following is a specimen course for (a) the Ordinary National Certificate in engineering, and (b) the Higher National Certificate in electrical engineering. This curriculum illustrates the kind of course followed by a part-time day student who hopes to gain a Higher National Certificate in electrical engineering. Those who seek Associate Membership in the Institution of Electrical Engineers must take additional 'endorsement' subjects as specified in the scheme below.

Entry qualifications: either (a) General Certificate of Education, 4 subjects; or (b) successful completion of the preparatory part-time 2-year General Course in Engineering.

Attendance: One whole day plus one evening per week for 35 weeks in the year.

The Ordinary National Certificate Course (electrical options)

Year	Subject	Hours per week
First (O.1)	Mathematics I	1.75
	Physics I	1.75
	Electrical engineering science	1.75
	Mechanical engineering science	1.75
	Liberal study	1.75
TOTAL		8.75
Second (O.2)	Mathematics II	1.75
	Electrical engineering (A)	1.75
	Electrical engineering (B)	1.75
	Physics II	1.75
	Liberal study	1.75
TOTAL		8.75

At this stage students sit for the Ordinary National Certificate in Engineering. Those who wish to qualify later for Associate Membership of the Institution of Electrical Engineers must also take physics (heat, light and sound) and mechanics at this stage. This may be done during a separate 1-year course, or by taking them as extra subjects during the O.2 or A.1 year respectively.

Below is a Higher National Certificate Course in electrical engineering.

Attendance: One day per week for 36 weeks per year, plus optional extra evening study.

Year	Subject	Hours
First (A.1)	Mathematics	2
	Electrical engineering	2
	Mechanics, or advanced physics	2
Second (A.2)	Mathematics	2
	Electrical engineering	2
	Electrical power engineering	2
	or	
	Electronics and electrical measurements	2

At this stage, students sit for the Higher National Certificate in electrica engineering.

Those seeking Associate Membership in the Institution of Electrical Engineers must take extra subjects for endorsement on their certificates: advanced physics II, advanced electrical engineering, advanced electrical laboratory, and two courses chosen from applied electronics, electrical measurements, electricity supply, utilization of electrical plant, electrical machinery, radio communication, and line communication, until they have completed all the requirements of the institution's Part III examination. Some of these subjects may be taken during the A.1 and A.2 years of the course by attending supplementary evening courses.

The complete course thus serves two purposes by providing (a) for terminal qualifications as technician, at Ordinary or Higher level; and (b) a second way of professional qualification at full engineer level. (Associate Membership is granted only after a minimum of 2 years in responsible employment in the electrical engineering industry.)

Programme of mechanical engineering technicians' course[1]

Part I is appropriate to the needs of apprentices and junior technicians. It may be regarded as complete in itself, or as an introduction to Part II which continues general technical studies and includes also a specialized study.

There is a third section for higher grade technicians which covers studies in applied technology and gains the award of Full Technological Certificate.

The scheme is designed to operate on a part-time day-release attendance or, 'block-release' basis, or other forms of study combining both college attendance and industrial training in one integrated whole.

The Part I course should occupy between 500 and 650 teaching hours

1 City and Guilds Syllabus No. 293.

extending over 2 years with part-time day studies or over 3 years with part-time evening studies.

The subjects are: workshop processes and practice (occupying 25 per cent of the whole course time); engineering drawing and materials; engineering science (with 50 per cent time spent in laboratory or demonstration work); mathematics; social studies; plus one optional supplementary subject, with 60 hours of teaching time, out of the following: non-metallic materials; electrical theory and practice; power production; basic physics; raw materials; melting and casting; forming and joining; others by application.

The Part II course should occupy from 500 to 650 teaching hours over a period of 2 years with part-time day or 3 years with evening attendance.

The subjects are: workshop technology (or a special technology), engineering construction and materials, engineering science, mathematics and social studies. There is one supplementary subject, 'applied technology', with 70 hours of teaching time. Alternatively, this may be deferred until after Part II is completed. This subject is mainly concerned with project and laboratory testing work done in small groups.

The Part III course should occupy not less than 240 teaching hours and comprises (a) study in one special technology, such as jig and tool design, mechanical engineering design, plastic mould design, thermal treatment of metals, etc.; and (b) an additional 70 hours in 'applied technology' if not already taken in Part II.

The successful student, upon termination of Part III, qualifies for the Full Technological Certificate of the City and Guilds of London Institute. Those completing only Part I or Part II are given certificates to that effect.

Direct entrance to the second or third years of the above course is permitted for those who have gained other similar qualifications.

Technician courses

A model 2-year post-high-school programme for electronic technology[1]

Course by semester	Hours per week				Semester credit-hours
	Class	Laboratory	Study	Total	
First year, first semester					
Technical maths.	4	0	8	12	4
D.C. circuits and machines	3	6	6	15	5
Social science	3	0	6	9	3
Technical drawing	1	6	2	9	3
Communication skills	3	0	6	9	3
TOTAL (First semester)	14	12	28	54	18
First year, second semester					
Technical maths.	4	0	8	12	4
Time varying circuits	3	6	6	15	5
Basic electronics	3	6	6	15	5
Shop processes	0	3	1	4	-
Technical report writing	1	0	2	3	1
Graphic analysis	1	3	2	6	2
TOTAL (Second semester)	12	18	25	55	18
Second year, third semester					
Engineering science	3	3	6	12	4
Circuit tracing	1	3	2	6	2
Electronic circuit design	3	6	6	15	5
Transmitter theory and operation	3	6	6	15	5
TOTAL (Third semester)	10	18	20	48	16
Second year, fourth semester					
Research report	0	6	3	9	2
Ultra-high-frequency and microwaves	3	6	6	15	5
Television circuits	3	6	6	15	5
Industrial electronics	3	6	6	15	5
TOTAL (Fourth semester)	9	24	21	54	17

1. United States Department of Health, Education and Welfare, OE-80009, 1960.

Two-year full-time course in construction technology[1]

This course is designed to prepare graduates to become assistants to architects, engineers, estimators and others in the construction field. Graduates of the programme hold such positions as structural steel detailers, concrete testers, architectural draughtsmen, assistant surveyors, etc.

Required courses over four semesters	Hours per week		
	Class	Laboratory	Credits
Projection drawing	—	3	1
Construction techniques	2	4	3·5
Elements of construction	2	—	2
Small house architecture	1	5	3
Construction methods and practices	3	5	4
Statics and strength of materials	5	—	5
Industrial architecture	1	5	3
Structural steel fabrication	1	3	2
Elements of steel detailing	1	3	2
Elementary surveying	1	2	2
Structural steel design	5	—	5
Construction estimating	1	3	2
Structural steel detailing	1	4	2·5
Route surveying	1	2	2
Reinforced concrete design	5	—	5
Mathematics I	4	—	4
Mathematics II	2	—	2
Physics	3	2	4
Communication arts electives	6	—	6
Social science electives	9	—	9
Total required credits			69

The total minimum hours above amount to 93, spread over four semesters, i.e., 23.25 hours per week, leaving some time free for further electives or remedial courses.

Admission is at 18 years upwards, after high-school graduation.

This curriculum is accredited by ECPD and also gains the Associate Degree in Applied Science (AAS) under the aegis of the Board of Regents of the State University of New York.

1. From the catalogue of the New York City Community College.

Example of curriculum for technicians

Four-year course, full-time, following 8-year elementary education

Subject	Lectures (+ practical work)			
	First year	Second year	Third year	Fourth year
Serbo-Croat	4	3	3	3
Foreign language	2	2	2	2
History, civics, economy	2	2	3	—
Mathematics	7	5	3	2
Technical physics	5	4	—	—
Chemistry	2	2	—	—
Mechanics	4 + 2	2 + 2	1 + 1	—
Technical drawing and geometry	3 + 2	—	—	—
Elements of machinery	—	3 + 2	1 + 2	—
Materials of testing	—	3 + 2	—	—
Production, organization	—		3	—
Hygiene and safety	—	—	—	2
Processing of materials	—	0 + 2	5 + 8	5 + 7
Works organization	—	—	—	2 + 3
Power production	—	—	2 + 1	1 + 2
Control	—	—	—	2 + 1
Maintenance and repair	—	—	—	1 + 1
TOTAL	29 + 4	26 + 8	23 + 12	20 + 14
GRAND TOTAL	33	34	35	34

EXAMPLES OF MULTIPLE-CHOICE 'OBJECTIVE' EXAMINATION QUESTIONS

UNITED STATES OF AMERICA

A question from a test on fundamentals of direct current in a 2-year technical school, for pupils aged 16-18, in electronics:[1]

Q. If a 10-ohm resistor and a 20-ohm resistor were connected in parallel across a 6-volt battery, and it was desired to know the current through the 10-ohm resistor an ammeter would be connected. . .

(a) across the 10-ohm resistor;
(b) across the battery;
(c) in series with the 10-ohm resistor;
(d) in series with the 20-ohm resistor;
(e) across the 20-ohm resistor.

} Tick the right answer

From a question paper on physics in a 2-year post-high-school course in a technical institute, for pupils aged 18-20 years:[2]

Q. If the coefficient of linear expansion for steel is 6.1×10^{-6}/°F. the expansion allowance for a 1,000 ft. steel bridge span subject to temperature variations from —20°F. to 160°F. would be:

(a) 0.502 ft. (b) 0.610 ft. (c) 1.100 ft. (d) 1.625 ft.

From the same paper:

Q. A wave motion will always transmit:

(a) sound impulses (b) energy (c) transverse waves (d) matter.

From a mathematics test paper for evening classes of technician level:[3]

Q. Given a triangle with vertices A (1,1) B (5,3) C (3,4) then the area of triangle ABC is:

(a) 11 (b) 29 (c) 8 (d) 3 (e) some other value?

From a quiz paper on electronics technology in a 2-year course in an Area Technical High School, for pupils aged 16-18.[1]

Match the circuits and descriptions shown opposite.

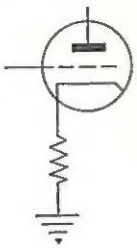
---

1. Supplied by Forbes Trail Area Technical School, Pennsylvania.
2. Supplied by Southern Technical Institute, Georgia.
3. Supplied by the Lowell Institute School.

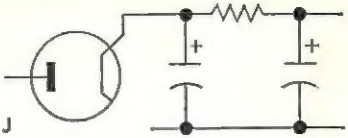
ELECTRONIC TECHNOLOGY RESISTOR FUNCTION QUIZ[1]

Match the diagrams shown, against the table, filling in appropriate letters.

A



J



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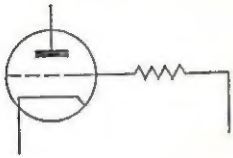

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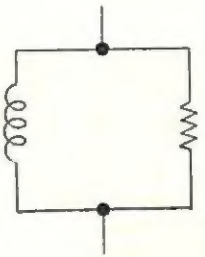

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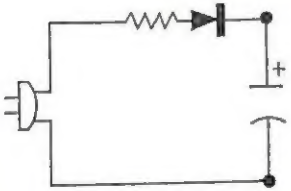

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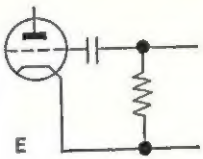

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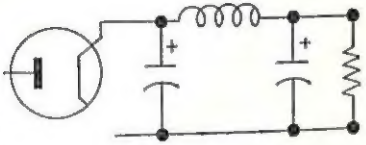
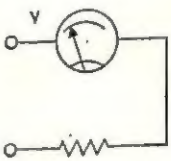


G



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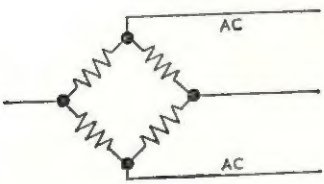

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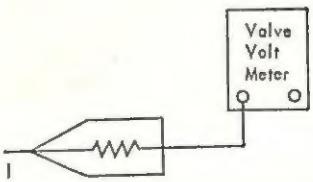

	1	Current limiting resistor		6	Range resistor
	2	Damping resistor		7	Parasitic suppressor
	3	Filter resistor		8	Bleeder resistor
	4	Cathode-bias resistor		9	Bridge resistor
	5	Isolation resistor		10	Grid-bias resistor

1, Supplied by Forbes Trail Area Technical School, Pennsylvania

From a selective admission test for vocational high school candidates, aged 14-15, in mechanical aptitude.

This is used in:
A. picking up small hollow objects
B. laying off distances
C. measuring outside dimensions
D. drawing circles
E. measuring inside dimensions

From an examination paper in the fourth quarter of a 2-year technician course in electronics and instrumentation:[1]

Q. The time it takes the electron beam to retrace horizontally or vertically is determined by:
(a) the horizontal and vertical sync pulses;
(b) the values of R, C and L associated with the vertical and horizontal circuits;
(c) the length of time between the sync pulses;
(d) the horizontal and vertical blanking signals.

1. Supplied by the Pennsylvania Technical Institute, Pittsburgh, Pennsylvania.